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ON THE

Meteorology of Newport.

METEOROLOGY OF NEWPORT.

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CORRIGENDA.—TABLE XII.

Column V.	(April),	line 17 (30.777),	read 29.777
		line 18 (479.938),	read 478.938
		line 19 (29.996),	read 29.934
Column X.	(September),	line 17 (30.842),	read 29.842
		line 18 (481.504),	read 480.504
		line 19 (30.094),	read 30.031
Column XIV.	(Sums),	line 17 (361.482),	read 359.482
		line 18 (575.5228),	read 573.5228
Column XV.	(Means),	line 17 (30.123),	read 29.957
		line 19 (29.975),	read 29.965

} THE SIXTEEN YEARS

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BODLEIAN
22 JAN 87
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SECOND EDITION.

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PREFACE.

In this record the meteorological statistics belonging to the locality directly concerned are given in considerable detail, as well as in mean values for long and fixed periods of the year according to the usual practice; and the hope is entertained that the facts may be worth preserving as matter of reference, though they should prove to be not calculated for continuous reading.

The attempt has been made to accompany the facts with explanations,—to show *how* the phenomena which occur cotemporaneously are connected together,—what they originate from, and what they lead to. The danger of thus venturing on hypothesis is freely acknowledged; and it has indeed been felt to be a question whether this branch of investigation might not better have been omitted. Theories, however, may be useful for the purpose of arranging, specifying, and identifying facts, when in themselves incorrect;—they may be so, even though they should have as little real or essential connection with the facts, as the figures representing the signs of the zodiac have with the groups of stars to which they are arbitrarily appropriated: and, it was thought that by thus showing a relation between the facts, and giving them a combined meaning, some additional interest might be lent to the otherwise dry detail of meteorological statistics. To leave our store of meteorological facts without any explanation seems too much like placing meteorology on the same footing with astronomy divested of the theory of gravitation—anatomy, or botany divested of physiology—or a collection of hieroglyphics without an interpretation: he who first attempts the interpretation may do good service, even though he should occasionally go astray;—the first road made through a country may be worth the making, though it should prove to be no more than a help towards ascertaining the course which the road should eventually take. There is a great difference between using facts to support theories, and using theories to explain facts: and the process here had recourse to is that of pointing out a hypothesis which seems to supply a means of explanation, and a bond of union, for a number of concurrent facts, the existence and concurrence of which had been previously ascertained by observation and calculation.

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PRELIMINARY CONSIDERATIONS.

THE nature and position of the site of observation will first be briefly considered: the instruments used, the arrangements made for their use, and the methods adopted in their use, will then be described: and, finally, the method pursued for rendering the results of observation available for meteorological purposes.

The garden in which the thermometers are placed is situated at an extremity of the town which is by no means much crowded with houses. Two mill streams run through the outskirts of the town, one of which runs near the garden: the garden lies at the lowest level of a valley which is nearly surrounded with hills, and is raised only 20 feet above the mean level of the sea, at the spot used for observation. To the southward there is a chalk hill rising 246 feet above the level of the garden, at the distance of one mile. On the north side the ground, which has an extensive clay surface, rises to 41 feet, at the distance of nearly a mile. On the east side there is a hill of gravel and clay 258 feet above the garden, at the distance of one mile. On the west side, a chalk hill rises to 425 feet, at the distance of nearly two miles. The valley in which the town is built has a clay soil. The latitude of the site is 50° 42′ N.; the longitude 5m. 9s. W.* Newport is supplied with excellent water from a deep and copious spring: means were taken to ascertain the temperature of this spring with accuracy. A standard thermometer which was used for determining the index errors of the other thermometers was inserted in a sort of bucket deep enough to include the whole length of the thermometer and made with double sides having an interval of half an inch between them: this was sunk to the bottom of the well through a hole in the paving just large enough to admit the bucket, 56 feet from the surface, and left there for several hours: the bucket was brought up rapidly filled with water, and the reading of the thermometer taken without delay,—the thermometer being drawn out of the water only so far as was necessary to take the reading: this process was repeated every week during the period of one year, and the mean temperature for the year proved to be 53°.40. The range was from 53°.3 in March and April, to 53°.6 on one occasion only at the end of December; the other three experiments in December giving 53°.5. The spring is 152 feet from the surface.*

---

* According to my late brother, J. M. B., 50° 42′ 2″, and 5m. 9.4s. According to Mr. Snook, St. Thomas' Church is in latitude 50° 42′ 1″, longitude 5m. 9.2s.

The thermometer stand is nearly surrounded with low walls and buildings, but is not nearer than 12 feet to any such object,—the nearest object being a thin brick garden wall. In constructing the stand the requisites kept in view were: 1st, to expose the thermometers thoroughly to the surrounding atmosphere; 2nd, to shelter them effectually from the sun's direct rays, rain, &c.; 3rd, to use the smallest possible bulk of materials in its construction; 4th, to keep the bulbs of the thermometers at a due distance from their protecting screens. It appears questionable if either of these objects could have been more effectually attained by any other arrangement than that adopted. The roofing consists of one horizontal flat plate of zinc with cross ribs of iron to give it the necessary strength; and an upper plate of zinc of somewhat larger area than the lower one, with shallow sides, the lower edges of which are placed about $\frac{1}{4}$ inch above the level of the lower plate: the upper plate is barrel shaped, to throw off wet and give a sufficient interval between the two plates in the centre where the thermometers are hung, lest the temperature of the upper plate—which would be modified by radiation and by the sun's rays—should be communicated to the lower plate; the atmosphere has perfectly free play between the two plates. The sides of the stand consist of mahogany louvre boards $\frac{1}{10}$in. thick: these were each so placed that the opposed edges of the boards just overlap one another everywhere sufficiently to shut out the sun's rays; and the sides just overlap the summits of the surrounding walls,—the walls being carried to such a height as to enable the observer to read the thermometers in a horizontal line beneath the proper screens of the stand: the stand is painted white on the outside, and dark green on the inside. The registering thermometers are suspended from the cross ribs of the roofing by means of wire hooks, and held steady by means of fine copper wires terminating below in check springs which have the requisite tension given to them by adjusting screws: by this arrangement the thermometers are readily unhooked, and when replaced are held sufficiently steady; the bulbs of all the thermometers, except the wet bulb, are suspended very near the centre of the stand, and are all 6½ inches below the roof, and four feet from the surface of the ground; the wet bulb is removed a little horizontally from the position of the other bulbs. The pair of wet and dry bulb thermometers are attached to the roof at their upper extremities: the water vessel is placed immediately below the thermometer bulb, supported upon a perpendicular slender stick; the vessel is of glass so that it may be readily ascertained whether there be a sufficient supply of water: distilled water was always used.

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* The temperature of the water in the well at Carisbrook Castle was found to be 2°.5 lower than that in the Newport well on the same day (Sept. 10, 1852): the temperature was found to vary considerably in the former well, but fortunately we have a good authority for the average temperature. The late Dr. Bromfield, who was devoted to scientific research and was noted as a careful observer, examined many of the Island springs, in all seasons: he has recorded 25 observations on the temperature of the Carisbrook spring, and the mean value for these is 51°.45: this gives an excess to the spring temperature over the adopted mean atmospheric temperature for Newport of 2°.07, whilst the Newport spring is 4°.02 in excess. Seven other springs are noticed in Dr. Bromfield's record (excluding "Occasional Observations,") viz., three at Newchurch, with 81 observations, giving a mean 50°.7: one at Bonchurch, 21 observations, mean 51°.2: one at St. Lawrence, 31 observations, mean 51°.5: one at Ashey, 21 observations, mean 51°.1: one at St. Boniface, 12 observations, mean 51°.4. The mean of the *six* mean values is 51°.2. The range of temperature for Carisbrook is 50°.1—51°.85; for Newchurch 49°.6—51°.85, 50°.35—51°.1, 49°.93—50°.85; Bonchurch 50°.35—52°.35; St. Lawrence 50°.6—52°.35; Ashey 50°.6—51°.6; St. Boniface 51°.1—51°.6: the range for the six localities is 50°.7—51°.5. It was found by very careful comparison that the indication of Dr. Bromfield's thermometer was identical with that of my own; the same correction was therefore applied to each.

Some precautions are required in order to secure correctness and accuracy in the reading of the thermometers: the thermometers are soon influenced by the heat of the body of the observer, and it is therefore desirable that the reading should be effected quickly; the wet and dry bulbs were therefore read together without stopping to set down the reading of either one first;—the tenths having been secured in this way the whole degrees were then ascertained leisurely. Another particular to be attended to is that of keeping the eye perpendicular to the part of the scale to be observed; where the scale is placed horizontally it makes a very appreciable difference in the reading, according as the right or the left eye is used, and this leads to one or the other eye being used to the exclusion of the other, but it may not be the same eye that is always used: a tube carrying a convex lens was used in reading; this is quickly adjusted to the end of the mercury, the eye is obliged to look in the one right direction, and this is done without the observer approaching very near to the thermometer, and the reading of the thermometer is very quickly determined.

An extra thermometer was kept in use during the years 1845-52 under a peculiar arrangement, with a view to obtaining some indication of the comparative heating power of the sun at different periods of the year;—this affording a better criterion of the temperature we ourselves, our dwellings, the surface of the earth, and vegetation are subjected to than the temperature of the air four feet from the surface does. The thermometer (a max. registering thermometer) was enclosed in a rectangular box which made a sort of oven heated by the sun's rays: the box was made of mahogany one inch thick; the front and back measure (outside) 13 inches by 12; the sides, 13 inches by 5; the bottom is left open, but elsewhere the box is air-tight: it is painted dark green: it was placed facing the South, attached at its back to the end of a projecting brick wall, so that it was very much isolated from surrounding objects. The thermometer was so placed that its cylindrical bulb was 5½ inches below the horizontal top of the box: the stem being brought down to a horizontal scale visible through a glass plate three inches from the lower edge of the box. The max. value for each day was the particular recorded: the highest value recorded during the eight years is 108°, in July; and the lowest 26°, in January; and the annual mean value for the eight years is 68°.5. A thermometer kept in this way indicates the heating influence of the sun, and affords information very different from that afforded by a thermometer which indicates the temperature of the atmosphere, or that of the sun's direct rays for the minute they may impinge on its bulb: it registers its max. value, on an average, a month later in the year than the air thermometer does, and ten weeks subsequent to the sun attaining his extreme N. declination.

The thermometers were obtained from various sources, but they have all been compared—and that repeatedly—with one good standard thermometer of Newman's; and the daily permanent record was made in the values belonging to this standard, though the actual reading of each individual instrument was noted on the spot. This standard thermometer was eventually compared with the Greenwich standard by Mr. Glaisher, and the recorded values were then all reduced in the final summaries to the Greenwich standard. The max. registering thermometer most trusted during the first twelve years, was one of Rutherford's construction, which is still unimpaired after being more than seventeen years in use: during the last four years one of Negretti's improved max. thermometers has been most trusted: the min. registering thermometers have been of Rutherford's construction from first to last.

The arrangements described above were not in use during the whole of the sixteen years; during the first twelve years the thermometers were kept under a different arrangement. Observations were made however during the last four years with thermometers placed under both arrangements; there was found to be a permanent difference in the results obtained from the two sources, and Mr. Glaisher having pronounced the later arrangement to be perfectly satisfactory, the values for the whole period were eventually made to conform to the indications given by this arrangement,—the old arrangement being continued in use for the daily record. Two maximum and two minimum thermometers were kept in use from the first: and this should always be done, as it affords some test of the correctness of the recorded values, and if any accident renders one unserviceable, the other probably remains available for use.

In the use of Daniell's hygrometer special precautions are needed, and have been used, in order to obtain as correct results as the instrument admits of. The principal error commonly committed, I believe, is that of pouring the ether over the ball too profusely and reducing the temperature thereby too rapidly to the point at which dew is deposited. Independently of the difficulty of catching the reading for the dew point correctly when this is done, the dew is actually deposited at an indicated temperature (may be by some degrees) above that which really belongs to the dew-point, and it is easily explained why it should be so:—when the temperature is reduced rapidly, the stratum of vapour immediately above the evaporating surface of ether in the bulb is much colder than any other part of the bulb, whilst the reading of the thermometer is determined by the whole contents of the bulb: the dew is consequently deposited on the zone of lowest temperature when this is considerably below the mean temperature of the bulb, and below that indicated by the thermometer: the temperature should be kept as much as possible the same throughout the bulb, and this is to be done by lowering the temperature slowly: it has been said that if this be done *too* slowly the surrounding atmosphere acquires moisture from the person of the observer; but I have always found, that the slower the process was conducted, the lower was the indicated temperature at which the dew was deposited, and I am in the habit of keeping the mercury at the point at which dew was deposited, for a sufficient length of time to know that the dew will not dry off again at the same point; which it will do when the temperature has been too suddenly reduced.* Another source of error is that arising from the breath of the observer reaching the bulb of the hygrometer: this was always guarded against by holding the breath whilst facing the instrument. If precautions are taken against these sources of error I am inclined to think Daniell's hygrometer a more satisfactory indicator of the dew-point than what is called Mason's hygrometer, or wet and dry-bulb thermometer,—an instrument which appears to be open to several objections, some of which at least are quite unavoidable.

The liability to the water having nearly or entirely evaporated from the vessel is a serious objection to the use of Mason's. When the temperature is at about the freezing point, (say just above 32°, whilst the wet bulb temperature is 31°) and the water consequently in the act of congealing or thawing on the wet bulb, the indications become uncertain and contradictory: if the temperature be clearly below freezing, it is then difficult to regulate the coating of ice upon the bulb properly; when the time of observation arrives it is probably found that the coating is insufficient, or it may be more than sufficient, and then protects the bulb from the cold; it is very probable that it will evaporate more quickly on one side of the bulb than on the opposite side. The atmospheric pressure appears to influence the indication of the instrument; and the same formula for calculating the dew-point will (if this be the case) not apply to different levels, nor to the same level with different readings of the barometer. Upon collating the several particulars concerned, as recorded daily during one year, it was found to be very generally the case that when the dew-point as deduced from Mason's hygrometer exceeded in value that obtained from Daniell's hygrometer, the barometer stood comparatively high, and vice versâ: as a mean result for the year, the atmospheric pressure was .170 in. greater when the deduced dew point exceeded Daniell's than when Daniell's exceeded the deduced: pressure impedes evaporation, and, when great, causes the wet bulb to indicate a higher temperature than it should do: the same takes place temporarily with Daniell's hygrometer, — the dew will deposit at a higher temperature than belongs to the dew point; but this *premature* deposit will dry off again, the condensation of vapour depending *permanently* upon the vapour pressure, not upon the air pressure. If one instrument indicates *directly* that which is sought for, and another does this *indirectly*, the former has clearly an advantage in this respect. It has been deemed sufficient in using Daniell's hygrometer to have an unequivocal, though very slight, deposition of dew formed, without waiting for the zone of dew to become dense, or wide; — possibly this may have been an error and the dew-point consequently have been taken one or two tenths of a degree too high, although I am of opinion that there was no error here, unless a departure from usual practice be such; but it is not desirable at any rate that the whole bulb or near the whole of it, should be covered with dew.* It may be worth observing that although it is important not to be too precipitate in reducing the temperature, — nevertheless, when there is a considerable interval between the atmospheric and dew-point temperatures, the ether may be used freely at first; it is only when the reduced temperature is brought within four or five degrees of the dew-point temperature that slow movement is called for; and indeed it is sometimes *necessary*—in consequence of the great interval between the two temperatures—to use the ether very freely, not only at first, but even to the last, for if this be not done, the low dew-point temperature will never be attained at all; and it may be necessary to keep the ball quite swamped in order to retain the mercury at so low a point as that of the dew-point: in these extreme cases the instrument does not give a correct indication, the dew-point being in fact somewhat lower than is indicated by the instrument: this shows that the instrument is not a perfect one—its indications, when the degree of dryness in the atmosphere is great, not corresponding with its indications when the atmosphere approaches to a state of saturation; and it follows from this that the range of the difference between the atmospheric and dew point temperatures is, probably, in fact more extensive than my statistics represent it to be,—that at the times when the atmosphere is particularly dry the degree of humidity is really less and the vapour pressure less than our instruments indicate. When the atmospheric temperature is far above the dew-point temperature, it becomes necessary to reduce the reading of the thermometer very considerably after a zone of dew has been formed before the whole of the ball will be dimmed; but if this latter condition were to be used as the criterion, the instrument would not be found to have scope enough to obtain the dew-point in a dry state of the atmosphere: it might probably be ascertained by experiment what correction is required, in proportion to the interval between the two temperatures *as indicated by the first deposition of dew*, for the purpose of determining the correct value for the dew-point temperature: the *correct value* must be below the reading at the time the dew is first deposited, and above it at the time the whole bulb becomes covered with dew. It appears that whilst Mason's hygrometer is subject to uncertain errors that do not admit of correction, Daniell's is subject to constant false indications which might be reduced to rule. Having four years of daily observations with both instruments to deal with, it was found, upon comparing the results, that upon the average, every month gives a higher dew-point, when deduced from Mason's hygrometer by Mr. Glaisher's Tables, than when observed directly upon Daniell's; the difference between the two varies from 0°.1 to 1°.8, according to the month; but it is to be noted that in those months when the atmosphere is driest, and when, consequently, the direct dew-point would appear to be too high, the indirect dew-point is then most in excess. It may be well to give the values as they were obtained for each month on the average of the four years: the first series of figures below shows the differences between the atmospheric and dew-point temperatures as ascertained by Daniell's hygrometer; the second shows the excess of the indirect over the direct dew-point.

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* The bottles commonly used for conveying ether to the ball of the hygrometer are not very well suited for such nice regulation of the supply of ether as is here recommended. I had a bottle made for the purpose with two holes through the stopper; one very minute for the admission of air, the other having one or two threads of cotton of loose texture passing through it which dipped into the ether; the other extremity of the thread supplied the fluid either in the smallest possible quantity, or in such quantity as was sufficient to swamp the whole bulb, according to the inclination given to the bottle: the stopper was covered with a cap the same as is used for spirit lamps.

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* The approved method of taking the reading, at the moment the dew appears and, again, when it disappears, must lead to great uncertainty and incorrectness; because, the mercury may rise and fall several tenths of a degree in a fraction of a second of time: under the method recommended above, the mercury is moving very slowly at the critical moment, its true position is easily determined, and the reading becomes that belonging both to appearance and disappearance.

January	4°.1	0°.1	July	7°.4	0°.6
February	5.2	0.1	August	7.9	0.8
March	6.6	1.0	September	7.3	0.8
April	8.2	1.8	October	5.1	0.1
May	8.0	1.3	November	4.0	0.5
June	8.2	1.2	December	3.8	0.1

The two instruments are made to accord in their indications on the average of the whole of the four years, by reducing the dew-point values of Mason's, for each of the 48 months, in proportion to the difference between the atmospheric temperature, and the dew-point temperature as determined by Glaisher's Tables; — the proportion being 0°.1 correction for every 0°.5 of difference, between 3° and 13°; 0°.1 being the correction for 3° and 2°.0 for 12°.5 of difference.

Table of Corrections for Dew-point ranging from 3° to 13° of difference.

Difference.	Correction.	Difference.	Correction.	Difference.	Correction.
3.0	0.1	6.5	0.8	10.0	1.5
3.5	0.2	7.0	0.9	10.5	1.6
4.0	0.3	7.5	1.0	11.0	1.7
4.5	0.4	8.0	1.1	11.5	1.8
5.0	0.5	8.5	1.2	12.0	1.9
5.5	0.6	9.0	1.3	12.5	2.0
6.0	0.7	9.5	1.4	13.0	2.1

If I had adopted Mason's hygrometer and used Mr. Glaisher's Tables for determining the dew-point, it would have been necessary to apply the above corrections subtractively, in order to make them correspond with the indications of Daniell's hygrometer. Having in fact adopted Daniell's hygrometer, it is necessary to apply these corrections additively, to make them correspond with the indications of Mason's hygrometer. But, I suppose similar corrections of small amount to be, *in fact*, required *subtractively* in the latter case, in order to obtain the true dew-point values.

Daniell's hygrometer was so placed as to bring the black bulb on a level with the eye, and a support was provided to give steadiness to the hand in applying the ether: there was a clear space of sky and light in front of the instrument: the instrument was habitually placed ready for use a sufficient length of time before the observation for it to acquire the temperature of the atmosphere: the hygrometer was purchased of Newman. It has been found an advantage to have some other kind of hygrometer to inspect, which required neither manipulation nor calculation, and judge thereby what amount of reduction of temperature would be required, prior to commencing the process of reduction. The enclosed thermometer was very carefully compared with the standard, and the recorded values were ultimately reduced to the Greenwich standard.

The barometer used is one of Newman's mountain barometers, the correction of which on account of capillarity is 0.32 in.: it was firmly and steadily fixed to a substantial wall, with a good light behind it, in a room that was subject to comparatively small variations of temperature: the cistern was 33 feet above the sea level. The instrument is made partly of mahogany, and the construction is such that very little correction is required for the alterations of the scale under the influence of temperature: the daily readings were therefore corrected for the temperature of the mercury, — 60° F. being the temperature for which the instrument was adjusted, they were reduced to this uniform standard, and corrected for capillarity, and capacities.

The actual effect of temperature upon the scale in the individual instrument having been subsequently ascertained by careful and protracted experiment; and the index error having been ascertained by comparison with the Greenwich standard; the values for the Tables were reduced to such as belong to 32° F., — including correction for expansion of scale which is very small for the actual range of temperature — the sea level, and the Greenwich standard. The reading was recorded daily at 9 a.m.: the mode of proceeding was this: — the side of the instrument having been tapped with the fingers so long as this produced any alteration in the height of the column — the alteration being very generally that of increase in the height of the column though upon being left to itself it subsided again to a small extent — the temperature of the mercury was then recorded; a magnifying lens was next adjusted to the summit of the column and the vernier lowered by the slow movement screw to the convex surface, and by the time this was done the column was restored to its equilibrium; the reading was then ascertained by the aid of a magnifying lens and recorded on the spot according to the actual reading. The lens used for adjusting the vernier is set in a frame which fits to the side of the instrument, and is readily adjusted with accuracy to its proper position in reference to the summit of the mercurial column. The figures having been set down, I then looked back to the scale and ascertained whether its reading accorded with the figures;—if any error had existed in these figures it would in all probability have been detected by this proceeding. The vernier is such as renders 0.001 in. easily appreciated.

Having been liable to be absent occasionally at the time of observation, I have, when this occurred, deputed others to note the reading of the attached thermometer, and to set the vernier to the summit of the column, leaving it to myself to register the reading afterwards.

The rain-guage used is one of Newman's, consisting of a copper cylinder into which the water runs from a comparatively wide receiving area above: the scale is attached to a ball floating on the surface of the water. During frost the cylinder was brought in-doors, but the same receiving funnel was used, placed in another vessel: the deposit in this vessel was brought in-doors, kept covered whilst thawing, and then poured into the cylinder, and there guaged. Snow was occasionally drifted out of the funnel instead of running through it, but this of course is only a rare occurrence. The rim of the funnel stands 3½ feet above the surface of the garden.

The number of days of rain recorded in the Tables is not in any way connected with the rain-guage: every day is included in the registry of this particular in which the smallest precipitation was ascertained to have occurred.

The cloudiness of the sky was not recorded in degrees of cloudiness for each day, but each day was recorded as being one of prevailing cloud, or prevailing clear sky: the mode of numeration for this particular is therefore similar to that adopted for the rainy days; *i.e.* the number of days on which cloud prevailed, out of the sixteen of the same date, is specified: and the average state of the sky for the whole day is referred to,—not that for any particular hour.

The direction of the wind was determined by the course of the lowest range of clouds, and their course was ascertained by means of a perpendicular staff which has each point of the compass marked around it on the ground at a sufficient distance from it. The four cardinal points were accurately ascertained by the position of the sun, and the intermediate points by division and subdivision of the intermediate spaces.

The prevailing wind for the whole day was registered; and for the purpose of detecting any alterations in its direction which might occur in the course of the day, as well as for use when no clouds were available, a vane was placed on the top of the staff: the vane was also used when the clouds were very elevated and evidently moving in a different direction from the atmosphere at a low level. By taking the direction of the wind in this way it is easy to appreciate the difference of a single point of the compass, and the direction was registered therefore with this division of the circle: — but in regard to the four cardinal points; if the direction were found to be ever so little on one side or the other of the cardinal point, it was registered as being one point on that side: and consequently, when the daily directions are thrown into four groups of which the cardinal points are the limits, the grouping is more accurate and defined than would usually be the case. In the process of grouping the daily directions into the four quadrants of the compass, the cardinal points (which rarely occur) are included in both of the adjoining quadrants; but the value ½ instead of 1 is then contributed to each of the two quadrants. When the wind was too variable to admit of any one direction being considered to prevail for the day, it was entered in the registry as "variable," and it is thus entered in the Tables.

An idea having been by many entertained that the S.W. winds had of late years become less prevalent than they had been previously, this point was made a subject of investigation:—the mean daily values, for the S.W., and also for the N.W. quadrant were calculated for the last four of the sixteen years, and the mean value for the S.W. quadrant proved to be identical with that for the sixteen years; that for the N.W. quadrant differed only by the value 0.1.

The force of the wind was recorded, with a scale of forces divided with a satisfactory degree of minuteness during the last four years only; and it has been thought best to trust to these four years as applicable to the whole sixteen, in this particular. No mechanical test for the force of the wind was had recourse to: it was estimated merely by common observation and recorded in what was considered to be the average value for the day. Extra notes were made respecting gales which existed during parts of days.

In regard to the hour of observation, there was but one adhered to: 9 a.m. being the hour at which I was least liable to be absent, this was selected for such observations as required to be recorded for some given hour in the day. It has already been stated that the direction and force of the wind, and the amount of cloud recorded, were not those which belonged to any particular hour, but the prevailing or average values for the day. A dairy being attached to the premises, the dairy-man's report was frequently trusted for the early morning: some of the family were always up late, and I was myself a frequent observer during the night: the registering thermometers were not read always at the same hour; but the minimum value that occurred prior to the maximum for the day was recorded; and the maximum that occurred after the minimum, or prior to the following minimum, was recorded. At one minute before 9 a.m. I commenced proceedings with the barometer; the instrument was at this time shaken, and a minute would probably elapse by the time the vernier was adjusted to the summit of the column: I then proceeded to the garden;—registered the readings of the wet and dry bulb thermometers first (during the four years that these were in use);—ascertained the value for the dew-point by Daniell's hygrometer; and then took the reading of the rain-guage. Perhaps when I speak of one minute before 9 a.m., this may appear like affected precision; but the fact is, that being acquainted with the time with sufficient accuracy for this, I was (whether this was needful or not) in the habit of observing this degree of punctuality:* Greenwich time was used, however, instead of the local time, and under this arrangement the height of the barometric column would be taken punctually at 9 a.m. Greenwich time; and the dew-point would be taken about as much after 9 *local time* as the atmospheric pressure was taken before this hour.

MEAN DIURNAL VALUES.

The reduction of the values for the different particulars observed, to their equivalent mean values for the 24 hours is an important matter for consideration, and the system pursued for determining the daily values requires to be stated. This point will be more fully explained in the Appendix, but it may here be stated that I have come to the conclusion (and acted upon it) that Mr. Glaisher's Tables for diurnal range are not equally applicable to all localities—that they should not be indiscriminately adopted for use—that in some instances a nearer approach may be made to the true corrections required, by some small modification of the Tables as they now stand. For mean daily temperature, Mr. Glaisher's Table applying to the arithmetical means of the two extreme values for each day has been used. For atmospheric pressure Mr. Glaisher's Table has beeen used without any alteration: the corrections required for this particular are of such small amount that it must be supposed that any modification required for difference of locality would be very insignificant, and it would require very extended and accurate observations to determine what the modification should be, as well as whether any be required: the diurnal variation in this particular probably depends upon the temperature of a considerable space rather than that of the particular locality immediately under observation; and in this case a difference in the nature of the locality would not affect the diurnal variation: the diurnal variation is probably much more affected by the nature of the barometer used than it is by the nature of the locality: the diurnal variation in the readings of a water barometer would probably differ widely (in high latitudes) from that of a mercurial barometer. The dew-point having been ascertained for one hour in the day only,—and this hour being one which appears to be connected especially with the influence arising from the nature of the locality—a slight modification of Mr. Glaisher's Table has been adopted.* The amount of cloud, the direction of the wind, the force of the wind, do not either of them require correction for diurnal variation, owing to the mode in which these particulars have been estimated.

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* The means at command for determining the time were a pocket chronometer of Dent's; an occasional sight of the Portsmouth time-ball, which with the aid of a good telescope may be seen from the neighbourhood of Newport; and a dipleidoscope which is fixed in the garden,—a useful meridian instrument invented by my late brother J. Mackenzie Bloxam, for which he took out a patent. The late Mr. Dent, sen., subsequently became the proprietor of the patent and manufactured the instrument for sale: it may now be purchased at 161, Strand, in a variety of forms. A short description of the instrument is given in the Supplement to Brand's Dictionary of Science, Literature, and Art.

MEAN ANNUAL LINE OF DAILY VALUES.

If half a dozen consecutive days should exhibit very varying, and irregularly varying temperatures, it would be evident that these precise temperatures were not the natural normal temperatures belonging permanently to the specific days on which they occurred. It is a desideratum, however, to determine with as much accuracy as possible what the permanent normal values for temperature, as well as for other meteorological particulars, are for different portions of the year,—not only for each month or week but even for each day in the year. An approximation to this is obtained by simply ascertaining the mean values belonging to a long series of years for each day; but the longest series of years that is available for the purpose will not give such regularly increasing and decreasing values as is desirable; and some method of reduction is, therefore, required beyond this, and it is desirable that the method should effect the object with a comparatively small number of years to deal with. The difficulty to be contended with is the liability in the reducing process to obliterate the normal as well as the abnormal irregularities: so much is this the case that it forms an objection even to adopting the mean daily values of a long series of years, as the values belonging essentially to the respective days: for, supposing the values to rise and fall (as they probably do) naturally in cycles of ten, twenty, or thirty years, such secular variations would be necessarily lost sight of in the process of reduction. The Tables have been constructed from values which have been reduced by a method which it is considered effects the object desired, without involving the objections alluded to. There being sixteen consecutive years of observation to deal with, it was better to combine the whole of these together in mean values; but if there had been 20 or 30 or any larger number of years to deal with, it might have been better to dispose of these in successive groups of 12 years each, in the same method as that used for the successive days. The method used for this purpose has now to be explained:—it is founded on the principle that the mean value of nine or eleven consecutive days gives more accurately the normal value for the central date of the nine or eleven—as the case may be—than the identical value which may happen to fall on that date: and so, the value assigned to each day in the year is the mean value of a given number of days on each side of its own date: the number of days adopted for the means is ten, this being by far the most convenient number for calculation; and the whole series of 365 days are thus made up of decadal means;*—the first mean value representing the decade 1-10, the second 2-11, the third 3-12, and so on: the date for the first mean value is then 5½, that for the second 6½, and so on; this process having been carried on all through the year, the new series of mean decadal daily values thus obtained is in turn treated in the same way; and now the dates become whole numbers again: this process is reiterated until the resulting values constitute regularly increasing and decreasing quantities,—*and no longer;* except that, in consequence of using the even number 10, it becomes necessary always to have an even number of reductions, in order to obtain whole numbers for the dates. By proceeding in this way the normal irregularities are preserved, whilst the small irregularities, which can only be accidental, are sufficiently obliterated from the thermometric values by repeating the process four times over: the same is the case with the dew-point values, but with the other particulars a two-fold reduction is found to suffice: but in order to reduce the thermometric values to one line of *constant* ascent and another of *constant* descent, it was found necessary to repeat the process 22 times: it may elicit some useful facts to carry the process to this extent, but for general purposes, and more especially for the purpose of determining the daily normal values, it becomes a process of derangement rather than one of correct arrangement.

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* See Appendix B.

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* The first series of decadal means consists strictly of *mean* values, but in the subsequent series this is not exactly the case: the nineteen *original terms* that are concerned in the computation of the second series have not all equal weight in the computation, and this inequality goes on increasing with every new series of decades. The number of the *original terms* included in the computation of each decadal mean goes on increasing by *nine*, with each successive series of decades: but whilst the range thus continually increases, the weight of the several terms preponderates more and more in the central terms,—so that the weight of each of the *original terms*, as it is involved in each computation, is in direct proportion to its proximity to the date under computation. It results from this that whilst the minimum thermometric value, in the 22nd series of decades (see Table I.) is 39°.4, the arithmetical mean value for all the original terms involved in its computation is 42°.9: and the corresponding values for maximum temperature are respectively 60°.9 and 55°.8.

The *pole of high temperature*, as elicited by the 22 reductions coincides in its position with that of max. temperature in the 4th series, but the *value* for max. temperature is reduced from 61°.4 to 60°.9. The position of the *pole of low temperature* falls between the two minima, viz: on February 6 instead of February 11,[1] (February 11 being the date of min. temperature, as determined by the four-fold reduction) and the *value* for min. temperature is raised from 38°.7 to 39°.4. The minimum value as it occurs in the 4th, 8th, 12th, and 16th series of reductions, respectively, is as follows, 38°.66, 38°.99, 39°.18, 39°.29: these values increase in tolerably regular geometrical progression, and if we suppose the first of these four to have been raised at the same rate as the others, this will give 38°.35 as the proper min. value instead of 38°.66, as it stands in the Table. If we deal with the maximum value in the same way it will be raised to 61°.48, from 61°.37 as it stands in the Table. The year is divided very nearly into equal parts by the poles of temperature, the Spring half consisting of 179 days, and the Autumn of 186. The Spring mean is shifted in its position from May 5 to May 2, and it is therefore probable that May 6 is a more correct date than May 5. The Autumn mean is shifted from October 20 to October 22, and it is therefore probable that October 19 is more correct than October 20. Each ultimate daily value embraces in its range as many as 199* days—under this excessive reduction.

There is a great advantage gained by adopting a method of reduction which will effect the object aimed at, without using the values belonging to a very extensive series of years; because, in the first place, the method is rendered thereby far more extensively applicable, and in the next place we do not incur the same hazard of distorting the real facts and deranging the normal progression of the daily values. Suppose that there are cycles of increasing and decreasing temperature extending over twenty years, and suppose that we have the materials of twenty or forty years' observation to use, and that the daily averages for the whole series of years are adopted for use;—it is very evident that in this case the secular variation would never be detected, and, moreover, that the mean daily values ultimately obtained would not be the normal values belonging to any period of the cycle, although they would of course represent correctly the mean values for the whole series of years that chanced to be used: even if there be not any such regular cycles (though there is reason to believe that there are), there may be irregular periods of high and low temperature which would be lost sight of by combining together too great a number of years, and which it might be desirable to preserve. Now the decadal method of reduction is not necessarily subject to these objections: suppose that instead of combining together the whole twenty years, we take successive groups of twelve years each,—and this number appears to be sufficient for the purpose—each group underlying its predecessor by one year, in the same way that the groups of decades of days have been made to underlie one another by one day, the secular variation of temperature would then be readily detected. The practice of throwing together a great number of years involves a sacrifice of individuality in favor of generality;—but the method proposed entails no such sacrifice.*

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[1] See Table I.

* See foot-note, page opposite.

The method of reduction here advocated has yet other advantages,—it gives no place for the exercise of any discretion; the results are those belonging to a simple arithmetical calculation, and must necessarily be the same (setting aside blunders) in every persons hands;—there is no opportunity for anything being lost or added in the gross sum—provided a correct method of calculating the decimals be practised;—and accordingly, the gross sum of the year's daily values after having been subjected to 22 reductions differed only by .52 from the gross sum prior to any reduction: the number of decimals was always maintained at two, and where the third decimal was a 5 this was *alternately* rejected, and counted as 1 in the second decimal.

ACCURACY OF THE CALCULATIONS.

As several corrections and modifications had to be made in the daily values, the calculations became somewhat extensive and complicated, and a doubt might arise as to the probability of accuracy being maintained throughout. Every step in the calculations was so subjected to checks and tests that the complication became a source of correcting errors instead of creating them. As examples of the care taken to avoid erroneous results, it may be mentioned that in obtaining the mean daily values for the sixteen years, the excess or defect that the division left for each day was always carried on to the credit, as it were, of the next day. In determining the annual mean values, the monthly means were not used for the purpose, but the gross sum was divided by 365: the various corrections (that for diurnal variation for example) were not used with the same monthly value throughout the respective months, but this value was reduced to its proportionate amount for each day.*

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* Supposing a succession of terms to be obtained—consisting of the mean values for consecutive periods of twelve years each; (and some multiple of four is always best, with a view to neutralising the derangement dependent upon the occurrence of leap years) there would then be no obstacle to throwing together any number of these terms that might be thought desirable,—either by the meaning process proposed, or by any other method; and this might be continued with every new year that was added to the original series.

The difficulty arising out of the varying number of days included in different years has been met by grouping together the days in their numerical order throughout the year;—so that not only are all the 59th days (Feb. 28) in the sixteen years combined together, but so also are all the 60th, and so on to the 365th: the 366th day, when it occurs, is rejected altogether, and consequently the interval between December 31 and January 1 is 1¼ day. The derangement arising from the occurrence of leap year is thus neutralized in the 365 days of the year by using any number of years which constitutes a multiple of 4.

DIVISION OF THE YEAR.

Having obtained the correct daily values for each particular throughout the year, the next process was to divide the year into appropriate portions, groups, or categories. In doing this it is obvious that the four seasons of the year constitute very appropriate and practically useful divisions—supposing, however, that such division is *meteorologically* correct, and not merely arbitrary; but the so called seasons, when constituted by grouping together three calendar months, are in fact arbitrary, and not meteorological. It is also desirable to divide the year into some smaller portions than those of the four seasons: but here, again, it is desirable that the division should be founded on some meteorological principle, instead of being arbitrary, or regulated by the almanack. The plan has therefore been adopted of limiting the seasons by taking the coldest 91 days in the year for the Winter, and the hottest 91 days for the Summer: the intermediate periods constituting Spring and Autumn. Then the year is further divided by taking the coldest 30 days, the hottest 30 days, and the two periods of 30 days each which come the nearest to the mean annual temperature, for the four cardinal divisions: this being done, the interval between each of these cardinal divisions is divided into two equal portions; and then we have twelve divisions, which would be better denominated sections than months. The year being thus divided under the law of temperature, the same divisions are maintained for the tabulation of each of the other particulars.—In accordance with this meteorological arrangement, the 365 days of the year are thrown into two orders of groups; the names, dates, and ranges of all which are here given:—

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* The monthly mean values for the sixteen years were calculated by two distinct processes:—under one process the sum, and the mean, of the daily values, was first computed for each of the 192 months; and then the sixteen sums and means belonging to each month were respectively summed and meaned; so that twelve groups of monthly sums, as well as of monthly means, and mean means, were ultimately obtained: under the other process the sum and the mean of the daily values was first computed for each of the 365 days in the sixteen years; and then the sums and the means belonging to each of the twelve months were respectively summed and meaned. If the corresponding sums obtained by these two processes were not identical, and the means similar, the calculations were revised and corrected: and double computations of this nature were extensively used upon other occasions.

Table of the Meteorological Divisions of the Year.

	Name.	Limits.	Range.	Name.	Limits.	Range.
				Section 1	January 25—February 23	30 Days
Meteorological.	Winter	December 15—March 15	91 Days	Section 2	February 24—March 22	27 ..
	Spring	March 16—June 16	93 ..	Section 3	March 23—April 18	27 ..
	Summer	June 17—September 15	91 ..	Section 4	April 19—May 18	30 ..
	Autumn	September 16—December 14	90 ..	Section 5	May 19—June 18	31 ..
				Section 6	June 19—July 20	32 ..
				Section 7	July 21—August 19	30 ..
				Section 8	August 20—September 12	24 ..
				Section 9	September 13—October 6	24 ..
				Section 10	October 7—November 5	30 ..
				Section 11	November 6—December 15	40 ..
				Section 12	December 16—January 24	40 ..

Much may be done to abridge the labor of the decadal reductions by suitable mechanical arrangements, but it is scarcely worth while to enter into a detailed description of these.

The principal objection to such divisions of the year as are here proposed, would probably be,—that different localities (so far as the limits or dates of the divisions are concerned) would require different divisions. But in reply to such objection it may be said, that in the first place it at once goes to show the utility of the plan; because, it affords a very advantageous means of comparing different localities with each other: in the next place, if the ample materials at the Greenwich Observatory were tabulated in this way, it would be quite as easy to make the periods thus determined the standard of tabulation for other localities, as it is to make the almanack the standard; thirdly, the adoption of one mode of tabulation does not preclude others, and there would be great utility in having the materials belonging to any one locality arranged in accordance with the almanack,—also in accordance with the Greenwich standard,—and, again, according to the law of the individual locality. When the daily values are once fixed by the decadal process it becomes far more easy to appreciate the contrasts between different portions of the year, and to group these values into any sort of categories that may be desired.

IMPERFECTIONS.

It is desirable that it should be stated what circumstances of an unsatisfactory nature are connected with the materials collected: I have occasionally been obliged to depute some one else to make the observations for me during my absence, and it has sometimes happened that I have been absent without any one to act for me, and this has led to occasional blanks in the daily registry;—this happened more frequently with the direction and force of the wind than with any other particular. When others acted for me, various precautions were used to prevent any errors being included in the register: when no observation was made in accordance with the established routine, it was sometimes thought better to trust to such evidence as bore upon the point, rather than to leave a blank; and this may frequently be done with advantage,—a note being left of the evidence upon which the value recorded was assumed. When a blank is left, this is in effect tantamount—so far as average values are concerned—to substituting for the blank the average value; and yet there may be evidence rendering it very certain that the proper value for the occasion differed materially from the average value;—it is better, then, to take the chance of the smaller error instead of the certainty of the larger one: the assumed value, it is true, can not be relied upon in its individual capacity, but it may be allowed to play its part as one in a multitude. On one occasion when the reading of the thermometer had not been recorded for three days together, I adopted the mean of the highest and the lowest temperature registered by the thermometers during the interval, as the mean temperature for each of the three days: sometimes, when I have been called away shortly before the hour for an observation, I have noted the reading just before departing, and upon returning soon after the hour, noted the reading again, and then computed the value for the proper hour from these two observations: both in this case and when only one observation had been made, I had recourse to Mr. Glaisher's Tables for diurnal variation (which may be made very useful in this way) as an assistance in determining the value belonging to the lost hour.* The values that have been determined in this sort of way of course cannot be relied upon individually and for all purposes, but I think they can not appreciably effect the accuracy of the ultimate adopted values. Some uncertainty exists as to the index error belonging to the barometer: the error was ascertained in the year 1856 to be −.007 in.; first and last the sound of the mercury tapping against the summit of the tube was clear and satisfactory. But in the year 1851 the instrument was left in Newman's hands for a day, and I never could learn whether any alteration had been made in this particular during the time, though I had particularly requested that attention should be paid to this point: I could not however, at the time, detect any alteration by comparing the readings with simultaneous readings of other instruments in the neighbourhood, before and after the date in question: but, recently this point has been subjected to a more conclusive test which makes it appear that a material alteration was made in the index error; and this has led to all the values dependent upon atmospheric pressure being re-calculated, with such an adopted error as the investigation indicated. Under these circumstances minute accuracy can not be predicated of those values which are affected by atmospheric pressure prior to July 1851, though these are all subject to the same error and therefore comparable amongst themselves; but there is no reason to doubt the accuracy of the values which involve, exclusively, the period subsequent to July 1851. The test had recourse to was this:—the sum of the Newport monthly barometer values for the period January 1, 1841—June 30, 1851 was compared with the like sum for Greenwich; and then a similar comparison was made for the period August 1, 1851—December 31, 1856: the difference exposed by the ultimate correlation was assumed to be the difference made in the instrument in the intervening month.

If the attempt should hereafter be made to show the connection of pathology, physiology, or vegetation with meteorology, it would be very desirable to arrange the facts collected, in such categories as would render them consistent, compatible and comparable with the different seasons and periods that have been found to obtain meteorologically—or that may hereafter be found to obtain.

The meteorological characteristics of different periods of the year will be discussed under the heads of the twelve "Sections" successively.

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* These Tables would be rendered much more useful if the time were given for *small* variations of value, instead of the variations in value (which are sometimes minute and sometimes large) being given for such long intervals as an hour.

STATISTICAL, ANALYTICAL AND SYNTHETICAL
REVIEW
OF THE METEOROLOGICAL YEAR.

The state of the atmosphere depends very much upon the nature of the surface of the earth beneath it, as well as upon the position of the sun, above it; and the control exercised by the sun varies according to the nature of the surface that is for the time most influenced either by his vertical or his oblique rays. It may be well, therefore, to premise a short statement bearing on these particulars. The parallel 50° N. latitude, which passes through the English Channel, encircles a peculiarly large proportion of land compared with the water: the land extends through 204 out of the 360 degrees,—the proportion of land to sea being about 5 to 4. At the tropic of Cancer the proportion is as 1 to 2: at the tropic of Capricorn as 1 to 3. At 50° S. latitude the narrow extremity of South America is the only land involved; and at 60° the surface is exclusively sea.*

The atmospheric phenomena which depend upon the hygrometric condition of the atmosphere are no doubt very much regulated, at the different intertropical parallels of latitude, by the varying situation of the sun's vertical influence, and by the varying nature of the terrestrial surface subjected to it: but the effects thus produced seem not generally to extend, in any marked degree, far beyond the limits of the tropics;—the atmosphere in the *inter*-tropical regions having no great tendency to flow into the *extra*-tropical regions. These latter regions are more affected by the *oblique* rays which fall upon and beyond the tropics, and their phenomena depend more upon the varying degrees of the obliquity.

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* This statement, though not pretending to minute accuracy, is sufficiently correct for its intended purpose.

Note—The figures in the margin printed in this type *29.963* always refer to mean annual values:—the figures printed in this type 38.7 always refer to extreme values, *i.e.* the maximum or the minimum for the year;—those in this type 40 refer to values of varying character.

SECTION I.

SECT. I.
Jan. 25—Feb. 23.

Sun's Decl.
19° S.—9°.9 S.

Section I. includes the thirty days of lowest atmospheric temperature,—beginning with January 25, and terminating with February 23.

The Sun's Declination* on the first of these dates is 19° S.; on the second it is 9°.9 S.—a position which brings a greater area of land under his vertical rays than was so placed in the preceding Section (*i.e.* Sect. XII.) The range of declination includes nine degrees, whilst in the preceding Section the range is only 4°.2.

40°, Jan. 25.[a]
38°.7, Feb. 11.[b]
40°, Feb. 23.[c]

The Atmospheric Temperature declines during the first part of this Section, and increases during the latter:—the range of temperature is consequently very small. The highest mean diurnal value is 40°, and this amount belongs to both the terminal days of the Section: the lowest diurnal value is 38°.7—the minimum value for the year,[1] on February 11. The date of the occurrence of this min. temperature is so much as fifty-two days from the date of the sun's extreme S. declination;—the sun having now advanced 9°.4 to the northward: an explanation will be given of this in the discussion of Section XII., which goes to show that the depreciation of temperature at this time is occasioned by the fact that the Arctic region is the source from which the atmosphere is derived, at this period of the year and in this locality. There is something rather remarkable in the suddenness with which a declining temperature is here exchanged for a rising temperature: seventeen days are occupied in reducing the temperature from 40° to 38°.7; and twelve in raising it again to 40°: the increment is at the rate 0°.11 per diem—the average rate from the minimum temperature of the year to the maximum being 0°.13 per diem: this seems to imply that the

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* The daily values for the sun's declination are the mean values for the four years 1847—1850.

[1] See Table I.

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Jan. 25—Feb. 23.

Sun's Decl.
19° S.—9°.9 S.

change from decrement to increment is not the result of the progressive movement of any one agent, but of a reversed ascendancy of two opposing agents. Two very marked minima of temperature occur in the year, and these are so much as thirty-seven days apart (the first falling on January 5): if the *meaning* of the daily values by the process of decadal reduction,[1] be continued to the extent of producing one mean line of ascending values, and one mean line of descending values for the year; the min. temperature then elicited, —and which may be regarded as the centre of gravity, or focal point of low temperature,—falls on February 6 and 7: this date may therefore be regarded as the position of the Pole of low temperature in the yearly circle, although the min. temperature occurs on February 11. The sun thermometer gives its min. value on January 11: it is therefore probable that if the direction of the wind were constantly S.W., the lowest temperature would occur a month earlier than it actually does: the preliminary minimum of Jan. 5 and this minimum of Jan. 11 afford strong evidence that it is not the position or progress of the sun that induces the minimum of Feb. 11. On this last date the sun thermometer has accomplished 20.8 per cent. of its whole annual rise.

The Dew-point Temperature declines from the first day of the Section to its min. value, both for the Section and for the year, at precisely the same rate that the atmospheric temperature does, *viz.*, 0°.08 per diem, but it ascends from this minimum until the last day of the Section at a much slower rate; from which it would appear that at the site of observation the atmosphere is supplied, to a considerable extent, from a region where there is a less proportion of vapour mixed with it, than would belong to the neighbourhood of the site. The min. value for the dew-point, which occurs on February 13, is 33°.76, and the difference at this date between the atmospheric and dew-point temperatures is 4°.95; but on December 3 —when the difference is at its minimum—it is 3°.55. The dew-point being 34°.4 on February 23 (last day of Section), it is 44°.6 on October 19, when the sun has the same declination; and the excess of the atmospheric temperature over the dew-point for these two dates

33.8, Feb. $\overset{\partial}{13}$.

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[1] See page 14.

Sect. I.
Jan. 25.—Feb. 23.

Sun's Decl.
19° S.—9°.9 S.

is, respectively, 5°.6 and 5°.0.[1] The prolonged high S. declination of the sun at the date of the conclusion of the Section would serve to account for the low atmospheric temperature at this date; but the prolonged action of the sun upon an extensive sea area would tend to augment, instead of diminishing, the quantity of vapour in the atmosphere, at the same time. The mean value for the dew-point in this Section, *viz.* 34°.3 is lower than it is for any other Section: but that for the month February is lower.[2]

The Atmospheric Pressure has a mean value the same (virtually) as that for the year, and the same also as for the preceding Section (Section XII.):[3] it would therefore appear that the atmospheric current is as strong *from* the site of observation as it is *to* it, during this period of the year. But on the first day of the Section (Jan. 25)—when the highest temperature that intervenes between the two minima occurs—the pressure is .018 in. below the annual mean: on February 15—four days after min. temperature—the pressure is .035 above the annual mean: and on the last day of the Section (Feb. 23) it subsides nearly to a casual minimum—which is still .004 above the annual mean.[4] From this it would appear that the decrement of temperature was accompanied with a preponderance of atmospheric flow towards the site of observation, and the increment of temperature with a flow *from* the site, and further, that the alternately advancing and receding atmosphere had an arctic (or at least northern) source. There is, in fact, great vacillation and contention amongst the different winds at this period, without any one gaining any great ascendancy.

29.970
− .018, J. 25.[a]
+ .035, F. 15.[b]
+ .004, F. 23.[c]

The Dry Air* Pressure in this Section has a mean value .084 in. above the annual mean, and .015 above that for the preceding Section:[5] on the first day this pressure is .052 above the annual mean; on February 15 it is .119 above, and on the last day (23rd) it is .083 above.

29.693
+ .052, J. 25.[a]
+ .119, F. 15.[b]
+ .083, F. 23.[c]

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* It would be better to substitute the word air for the usual expression "dry air," and when the word "air" is used it will signify *dry air*, that is to say atmosphere minus vapour;—the word atmosphere signifying the natural compound element—air plus vapour.

[1] See Table VI. [2] See Table VII. [3] See Table XI. [4] See Table X.
[5] See Table XV.

— .071, J. 25.[a]
— .083, F. 15.[b]
— .079, F. 23.[c]

The Vapour Pressure on the dates just referred to (January 25, February 15, February 23) is below the annual mean[1] by the respective quantities .071 in., .083, .079. From these particulars it appears pretty evident that when the atmosphere accumulates at the site of observation and the temperature falls, the accumulation depends, greatly, upon the supply contributed by a region where the proportion of vapour is comparatively small, and vice versâ.

78.6

The Humidity of the atmosphere for the Section is 3.1 above the annual mean, and 5.5[1.] below that for the preceding Section which gives the highest value.

.090

.113, Jan. 25.[a]

.064, Feb. 16.[b]

The Fall of Rain, which had been very abundant during the four preceding Sections, very much abates in this,—the mean value .080[2] in. falling considerably below the annual mean, and the quantities for each day[3] being (with the exception of the three first) all below the mean for the preceding Section: the period of condensation and deposition has fairly ceased at the date of this Section's commencement,—the atmosphere being now effectually drained of its aqueous constituent, and the earth thoroughly saturated. A period in which evaporation preponderates over condensation is about to set in; it cannot be said to have done so yet. The fall on the first day is .113 in., and the quantity for each day after this progressively diminishes until the 16th February,—as it had done during the six last days of the preceding Section: the quantity on the 16th is reduced to .064. By comparing these dates with those previously given in connection with rising and falling temperature it will be found, that the Fall increases and decreases with the atmospheric temperature; and consequently, the small quantity of vapour that is combined with the atmosphere upon the occurrence of min. temperature, cannot be attributable to copious deposition (at the site of observation at any rate).

$\frac{8.6}{16}$

Jan. 25.[a]
Feb. 16.[b]

The Rainy Days in this Section are less numerous than in the two preceding: the representative value for this Section is $\frac{9.4}{16}$,[4] and as the annual mean is $\frac{8.6}{16}$, the excess for this Section is 0.8. The number of rainy days decreases from the first day until February 16, when the value is 8.2—or 0.4 less than the annual mean.

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[1] See Table XV. [2] See Table XVII. [3] See Table XVI. [4] See Table XIX.

SECT. I.
Jan. 25.—Feb. 23.

Sun's Decl.
19° S.—9°.9 S.

$\frac{9.1}{16}$

Jan. 25.[a]
Feb. 15.[b]

The Cloudy Days are less numerous than in the two preceding Sections: the representative value for the Section being $\frac{10.3}{16}$,[1] this gives an excess of 1.2 as compared with the annual mean. The number decreases from the first day until February 15, when the value is reduced to 9.2—only 0.1 above the annual mean. It appears from the evidence of this and the preceding particulars, that the atmosphere in its higher strata, as well as in that immediately above the surface of the earth, at the period of min. temperature, is far from being in an extreme state of humidity.

.159

.217, Jan. 15.

.208, Jan. 25.[a]
.180, Feb. 16.[b]

The Daily Change* in the atmospheric pressure is great in this Section: the excess over the annual mean is .029 in.: the two preceding Sections are the only ones that give so high a value.[2] The high value in this Section may be accounted for by the frequent shiftings of the wind between N. and S. The daily values progressively diminish from a casual maximum of .217 on January 15, —three days short of the casual max. increment of temperature— and .208 on the first day, to .180 on February 16.

SECTION II.

SECT. II.
Feb. 24.—March 22.

Sun's Decl.
9°.5 S.—0°.5 N.

Section II. includes twenty-seven days;—commencing February 24, and terminating with March 22.

The Sun's Declination for these dates is 9°.5 S. and 0°.5 N.: the sun's advance to the North during the Section is great,—amounting to ten degrees. The areas of land and sea subjected to the sun's vertical rays remain pretty much the same throughout this Section as they were in the last; but a great extent of land in Africa, Asia, and Europe is brought under the strong influence of his oblique rays, in exchange for a lesser extent of sea which loses it on the south side of his position.

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* The particular referred to under this expression is the mean daily change in the pressure,—including both increment and decrement—at 9 a.m.; and this must not be confused with the amount of excess of one or the other of these on the average of the sixteen years.

[1] See Table XX.

[2] See Table XIII.

SECT. II.
Feb. 24.—March 22.

Sun's Decl.
9°.5 S.—0°.5 N.

49.4

The Atmospheric Temperature undergoes some considerable increment in the course of this Section,—the rate of increase being 0°.09 per diem, whilst the average rate for the total increase is 0°.13: the temperature for the first day is 40°.1,—that for the last 42°.5. The temperature for the day on which the sun is vertical to the Line, *viz.*, March 21, is 42°.35,—7° below the annual mean: on the sun's attaining the same position in the fall of the year, the temperature is 7° (6.7) above the annual mean. On March 3, the increment of temperature subsides nearly to 0;—the N.E. wind having on this date acquired a decided preponderance. On March 21 the atmosphere thermometer having effected 16.3 per cent. of its annual rise, the sun thermometer has risen 33.2 per cent.

43.1

The Dew-point Temperature is 34°.5 for the first day, and 35°.5 for the last—the increase being at the rate 0°.04 per diem, whilst the rate for the total increase is 0°.12 per diem: the increment therefore that takes place during the Section may be said to be small, and is by no means in proportion to that of the atmospheric temperature: during the first few days of March there is rather a decrement than an increment in the values. On the last day the difference between the atmospheric and dew-point temperatures amounts to 7°,—the annual mean for this particular being 6°.3: this difference on September 23 is 6°.7: but when the atmospheric temperature attains the same value in the fall of the year, *i.e.* November 26, that it has on the last day of this Section, the difference is only 3°.7,—scarcely above the minimum.

3.55

The Atmospheric Pressure stands at a very high value in this Section; there is but one Section for which the mean value is so high, *viz.*, the one following the Section of highest temperature. The Second Section having the highest pressure value but one, is followed by the Section which has the lowest value; Section VIII., which has the highest value and succeeds to the Section of highest temperature, is followed by the month October which has the lowest value of all the twenty-four divisions. The Section commences with a casual minimum, which, however, just exceeds the annual mean: the daily values increase until March 8, when the maximum for the Section, 30.125 in., is attained; and then they decrease to (nearly) a casual minimum on the last day.

+ .003, Feb. 24.[a]
+ .155, Mar. 8.[b]
− .065, Mar. 22.[c]

The Air Pressure has a value exceeding that of any other of the twenty-four divisions of the year; *viz.*, 29.826 in. On the first day this pressure is 0.82 above the annual mean; on March 8 it is .233 above; and on the last day it is .005 above: on the 8th the max. value for the year is attained.

29.693
+ .082, Feb. 24.[a]
+ .233, Mar. 8.[b]
+ .005, Mar. 22.[c]
29.926

The Vapour Pressure being greatly dependent upon temperature, is of course at this period of the year still of low value: but the defect is far greater than the period of the year might lead us to expect: the mean for the Section is .076 in. below the annual mean: the defects for the three dates just referred to are, respectively, .079, .078, .070. The accumulation of atmosphere that takes place on March 8 is thus shown to be very great, and the amount of dry air is at the maximum for the year on that day, whilst the weight of vapour in a given bulk of atmosphere is nearly at its minimum for the year, *viz.*, 2.36 grains in the cubic foot: the vapour pressure is very low, and lower even than it is all through January, notwithstanding the great accumulation of atmosphere. The peculiarities in the constitution of the atmosphere here noticed may be all accounted for by supposing the Arctic regions to be the source from which the atmosphere is derived; and the large amount of its principal ingredient may be accounted for by supposing that this current from the North is met at a more southern latitude by a current from the South: excess in the air constituent, however, is proper to the season, and it would appear that the atmosphere from the North containing a small quantity of vapour meets the atmosphere from the South containing a large quantity of air.* On the 23rd September the atmospheric pressure is .044 greater than on March 22; but the air pressure at the former date is .102 less than at the latter date,—the vapour pressure being .146 greater at the former than at the latter date: the vapour pressure, which is .078 below the annual mean on March 8, and .070 on March 22, is .076 above the annual mean on September 23.

− .079, Feb. 24.[a]
− .078, Mar. 8.[b]
− .070, Mar. 22.[c]

The Humidity for this Section is the same as that for the year: the value for March 8 is 2.5 below the annual mean.

78.6

Considering that at the spring equinox the sun has passed up to the Equator over an extensive sea area, and that at the autumnal

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* This will be more fully discussed under the head of "Elastic force of Atmospheric Fluids."

Sect. II.
Feb. 24—March 22.

Sun's Decl.
9°.5 S.—0°.5 N.

equinox he has passed down to it over an extensive and dried land area, it might be expected that the vapour pressure would be greatest in the Spring: but there are several circumstances tending to an opposite result;—first, the terrestrial surface subjected to his *oblique* rays, north of the tropic of Cancer, is placed under conditions very different from those which obtain in the latitudes subjected to his vertical rays: the sea immediately north of the tropic would increase in temperature continually and considerably from the vernal equinox to the autumnal equinox, and would, consequently, yield an increasing supply of vapour to the atmosphere north of the tropic; secondly, the temperature of the atmosphere also is higher in the Autumn than in the Spring, and consequently admits of a larger quantity of vapour being mixed with it;—thirdly, the atmosphere has been drained of its aqueous constituent in the Spring by the cold of Winter; the result is, that the vapour pressure does not again reach so low a value as it has on March 8 until February 3: looking to these circumstances, the difference between the atmospheric and dew-point temperatures might be expected to be very materially less when the sun is approaching the Equator from the North, than when he is approaching it from the South; and probably this is the case in by far the greater part of the land districts lying in the same latitude as the site of observation, though it is not so in this neighbourhood, owing to causes that will be explained whilst discussing Sections VIII. and IX.

The Fall of Rain is .022 in. below the annual mean: the smallest amount for any one day in the year is .051, on March 10 :— the highest value falls on October 3.

.051

$\frac{8.6}{16}$

The Rainy Days are below the annual mean by the amount 0.5; and on March 8, when the min. value for the Section occurs, the defect is 1.4.

$\frac{9.1}{16}$

The Cloudy Days are above the annual mean by the amount 0.1: on March 8 a casual minimum is attained which is 0.2 below the annual mean: the min. value for the Section is 8.4,—0.5 lower than that on the 8th.

The Daily Change in the atmospheric pressure at 9 a.m. is .020 in. above the annual mean: this particular attains the max. value for the Section, .207, on Feb. 27,—the maximum for the year being .210.

Sect. II.
Feb. 24—March 22.
Sun's Decl.
9°.5 S.—0°.5 N.

It has been stated that the period of condensation and deposition had ceased at the commencement of the first Section: it may now be stated that a period of evaporation is established in the course of the second Section. As a general rule, in proportion as the temperature of the atmosphere is increased, so is the proportion of vapour augmented,—and vice versâ; but at this period, the proportion of vapour existing in the atmosphere is small in proportion to the temperature, and, as a consequence, evaporation is very active from the surface of every body that contains moisture and is exposed to the air. The increase of vapour in the atmosphere, however, can continue only to a limited extent: as soon as the limit is passed condensation and deposition ensue; and consequently, during that portion of the year in which the temperature is constantly rising, a succession of short periods of alternate evaporation and deposition is established,—neither of the two ever acquiring (as a general rule) any great ascendancy over the other. It is probably the opposite electric intensities occasioned by these two actions going on between the earth and the atmosphere that immediately determines the exchange of these conditions one for the other,* though the quantity of vapour that *can* exist in the atmosphere is always limited by its temperature; and it is, probably, generally very nearly at this limit—*i. e.* the point of saturation—that deposition takes place, though the tendency to rain is very far from being constantly in proportion to the proximity to saturation. These alternate periods of deposition and evaporation are found to be very regular upon reviewing the average daily values of a long series of years,—and very remarkably so when these are further averaged by the decadal reducing process: they would probably be found to be very regular by merely bringing under view the mean results of an extended area.

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* This alternative action and influence of electric tension in causing and precluding rain seems to be well illustrated in the Spring when for two or three days in succession hoar frost appears in the morning and brilliant sun-shine during the day;—conditions eminently calculated to produce great and accumulating electric tension, and which are almost infallibly followed by rain, however determinedly fine the weather may appear to be. It seems highly probable that one electric condition should cause the vesicles composing a cloud to press together, and towards the centre of the cloud; and, to *combine together*, form water, and descend as rain; whilst another electric relationship would cause the vesicles to separate and diffuse themselves.

SECT. III.
March 23—April 18.

Sun's Decl.
0°.9 N.—10°.7 N.

SECTION III.

Section III. is one possessed of no very marked characteristics. It includes 27 days; commencing March 23, and terminating with April 18.

The Sun's Declination on the first day is 0°.9 N., on the last day 10°.7 N. The area of land brought under the sun's vertical rays is somewhat greater in this Section than in the preceding,—what is gained in Africa more than counterbalancing that which is lost in America. At the conclusion of the Section, however, the sun is vertical to the southern limits of the peninsulas of Asia, and the full force of his oblique rays falls on the vast tracts of the continents of Asia and America,—but, also, on large sea areas in the N. Atlantic and N. Pacific Oceans. The sun does not make quite so great an advance to the North in this Section as in the preceding.

.13 **The Atmospheric Temperature** has a mean daily increment of
49.4 0°.17; the temperature on the first day being 42°.7,—on the last 47°.1: the max. increment for any one day in the Section is 0°.26, on March 30.

.12 **The Dew-point Temperature** has a daily increment of 0°.11; the value for the first day being 35°.6,—for the last 38°.6: the two temperatures advance more at an equal pace than they did in the
April 10. preceding Section: on April 10 the daily increase is reduced to next to 0, and the increase in the atmospheric temperature is reduced on the same date to a casual minimum of 0.1. The difference between the two temperatures for the Section is 1°.34 in excess of the annual
6.3 mean, and 1°.4 in excess of that for the preceding Section: the smallest difference during the Section is 7°.1, on the first day,—the greatest 8°.5., on the last day.

The Atmospheric Pressure has a lower value for this Section than for any other of the Sections: it is .058 in. below the annual
29.970 mean value, and .115 below the value for the preceding Section:
April 7. the pressure attains a casual minimum on April 7.

The Air Pressure declines greatly in this Section,—being .005
29.693 in. below the annual mean, and .138 in. less than in the preceding Section. Augmentation of this pressure obtains for each of the five preceding Sections, and diminution ensues for the 5th, 6th and 7th
April 7. Sections. This pressure also attains a min. value on April 7.

SECT. III.
March 23—April 18.

Sun's Decl.
0°.9 N.—10°.7 N.

The Vapour Pressure is .0525 in. below the annual mean. The second Section showed a commencing augmentation in this pressure, and the augmentation continues in this and the four succeeding Sections.

It has been shown that the atmosphere contained a very small quantity of vapour on March 8, and upon this date commence changes which progress till April 7. The changes in regard to the gaseous pressures during this period of time stand thus:—the compound element loses 239 in., the air constituent loses .270, the vapour gains .031: the increasing influence of the sun is manifested in the considerable increase of vapour, whilst the air is considerably diminished.

Atm. — .239.
Air — .270.
Vap. + .031.

The Humidity for this Section is 4.7 below the annual mean, and this Section makes the fourth of progressive diminution. The diminution between March 8 and April 7 is 3.4, and a further reduction takes place subsequently, April 21 having a value 4.4 lower than the 7th,—the value for the 21st being the lowest in the year, *viz.*, 71.7.

Hum. — 3.4.

The Fall of Rain is small, the daily average for the Section as well as for the month of March being .065 in.,—a lower value than that belonging to any other of the twenty-four divisions of the year: the daily Fall does not vary much throughout the Section.

The Rainy Days in this Section are just the same as the average value for the year. The max. value for the Section, *viz.*, 9.1, occurs on April 10.

$\frac{8.6}{16}$

April 10.

$\frac{9.1}{16}$

The Cloudy Days are 1.2 below the annual mean. A commonly clear sky with sudden showers of short duration, of rain, sleet or snow is a combination of frequent occurrence at this period of the year, and the combination is frequently connected, apparently, with distant deposition, and with a northerly wind.

The atmospheric changes which occur between March 8 and April 7 at the site of observation all point to the same occurrence as giving origin to them:—the check that occurs in the rise of atmospheric temperature on April 10,—the suspension of the rise of the dew-point on the same date,—the min. pressure of the atmosphere and of the air on April 7,—are all consistent with and explained by the supposition, that a great fall of rain or snow occurred at that date in northern latitudes, either on the eastern or

Sect. III.
March 23—April 18.

Sun's Decl.
0°9 N.—10°.7 N.

western continent; and it is highly probable that such fall should occur: the snow covered tracts in the north of Europe having necessarily a much lower temperature than the English channel and its neighbourhood, the fall there would produce a drain upon the vapour which would carry the air along with it, and this would be felt especially in a line extending to the English Channel and the Atlantic, where the vapour has its source: the increased amount of vapour would be quite consistent with the hypothesis, because the augmenting vapour would be as necessary as the comparatively low temperature of the locality, in determining the fall there: the increment of temperature belonging to the period of the year would be inoperative at the locality in preventing the Fall, so long as there was a large mass of ice and snow to absorb the heat: on April 3 the S.W. winds and the force of wind attain high values. The suspension of the rise of the dew-point, and a change of wind to the N.E., on April 10, with very high values for the S.E., which increase from the 12th to the 26th, and the min. value for humidity on the 21st all point to the western continent becoming subsequently the site of controlling deposition. The augmentation of humidity on and after April 22 would indicate the date on which the Fall abates.

The Daily Change in the atmospheric pressure is just below the annual mean: the daily values decline, almost constantly, from the beginning to the end of the Section.

.159

SECTION IV.

Sect. IV.
April 19—May 18.

Sun's Decl.
11°.1 N.—19°.5 N.

Section IV. embraces the 30 days in the Spring of the year, the value for which comes nearest to the mean temperature of the year: the terminal dates are April 19, and May 18.

The Sun's Declination is 11°.1 N. on the first day,—19°.5 N. on the last. The parallel first indicated crosses the extreme width of Africa; and between the two lies Arabia, Hindostan and Siam: the accession of land thus obtained has to be balanced against the exchange of the narrow northern portion of S. America for the Caribbean Sea. The sun's rays acquire great power immediately north of the tropic, where a great expanse of sea exists.

SECT. IV.
April 19—May 18.

Sun's Decl.
11°.1 N.—19°.5 N.

The Atmospheric Temperature for the first and last day is, respectively, 47°.2, and 52°.6,—giving an increment a little exceeding that which occurs in the preceding Section, and a daily rate exceeding it by 0°.02; the rate exceeds that of all the other Sections, and exceeds the total mean by 0°.06: the daily increment reaches the max. value for the year, 0°.28, on May 16. The annual mean value for temperature occurs on May 5,—forty-five days after the Equinox: the same value occurs, in the Autumn, on October 20—twenty-seven days after the Equinox. The increment of temperature here is remarkable—connected as the period is with the black-thorn winter: the impression of cold so noticed at this season seems to result from the dryness of the atmosphere, instead of its coldness—the increment of temperature being 0°.13 on each of the six days April 18—23, and the rate increases subsequently: April 21 is the date of the most active evaporation. On May 5 the atmosphere thermometer having risen 47.6 per cent., the sun thermometer has risen 62.3 per cent.[1]

.13
.28
49.4
45 aft. Eq.
27 aft. Eq.

The Dew-point Temperature rises rapidly during this Section: the value for the first day is 38°.6,—for the last 44°.7: the rate of the increase is therefore 0°.21 per diem; a value which exceeds the corresponding one for atmospheric temperature,—is in excess of the same particular for the preceding Section by 0°.10,—is in excess of the same particular for any other Section,—and is 0°.09 in excess of the total mean value. The max. rate for any one day in the year is 0°.28 on May 16. The annual mean for the dew-point, *viz.*, 43°.0, occurs on May 12,—seven days after the occurrence of mean atmospheric temperature: the mean dew-point occurs again on Oct. 31,—eleven days after the atmospheric mean. The atmospheric and dew-point temperatures advance as in the preceding Section with considerably uniformity, but instead of forming two diverging lines they now form converging lines. The difference between the two temperatures is greater for this Section than for any other of the twenty-four divisions: the max. difference for the year is 8°.7, on April 25.

.12
.28
52 aft. Eq.
38 aft. Eq.
8.7

The Atmospheric Pressure, is still below the annual mean, the defect being .021 in.; but it exceeds that of the preceding Section by .036: the pressure having attained a casual maximum on the first

+.036

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[1] See Page 3.

day, very little alteration then takes place to the end of the Section,
$-.031^{b}$ the value for the last day being .031 below that for the first.

$+.023^{a}$ **The Air Pressure** is .023 in. in excess of the value for the
$-.095^{b}$ preceding Section; the value for the last day is .095 below that for
the first.

$+.034^{a}$ **The Vapour Pressure** is .034 in. above the value for the preced-
$+.061^{b}$ ing Section: the value for the last day is .061 above that for the
first.

In the discussion of Section III. it was suggested, that its characteristic phenomena—which may be more especially referred to the date April 7—might be accounted for by the occurrence of copious depositions at the time in Northern Europe or Northern America: the subsidence of this, subsequently, and its cessation on the first day of this Section, or soon after, would suffice to explain the characteristic phenomena of this Section;—the cessation of deposition enabling the atmosphere at the site of observation to recover its proper balance: the restoration of the normal condition is effected by a simultaneous increase in the amount of vapour, and diminution in that of air: the increase is great, and it probably occasions the diminution,—the one ingredient supplanting the other; the daily rise in the dew-point temperature reaches its max. value for the year, *viz.*, 0°.28, on May 16.

The Humidity is .05 lower than for the last Section, and 5.2
76.6 below the annual mean. The humidity reaches its min. value for
71.7 the year, *viz.*, 71.7, on April 21: on this day the *atmosphere*
thermometer having been raised 39 per. cent. of its whole annual
range of mean temperature, the *sun* thermometer shows a rise of 48
per cent. in the annual range of *its* recorded daily values.

The Fall of Rain is .007 in. in excess of that for the preceding
Section,—an excess attributable to cessation of deposition in the
North-East or some other region. The fall is still .018 below the annual
.090 mean value. The daily quantities vary only from .086 to .065.

The Rainy Days increase constantly,—the Section beginning
with the number 7.5, and ending with 9.3: the mean value for the
$\frac{8.6}{16}$ Section is 0.3 below that for the year.

The Cloudy Days, on the whole, increase during the Section,
the number for the first day being 7.6, for the last 8.2: the mean
$\frac{9.1}{16}$ value for the Section is 1.4 below that for the year. It appears,

Sect. IV.
April 19—May 18.

Sun's Decl.
11°.1 N.—19°.5 N.

therefore, that this period of the year is characterised by partial depositions of short duration, rather than by general condensation of vapour. The hygrometric peculiarities of this Section are attributable, in great measure, to the position of the sun as alluded to above in regard to sea and land areas.

The Daily Change in the atmospheric pressure is .020 in. below that for the preceding Section, and .019 below the annual mean. This section is very exempt from any sudden changes in any repect.

.159

The 5th of May being the date of mean annual temperature, it may be well to collect a number of particulars belonging to this date, with a view to a comparison with the corresponding particulars at the opposite but corresponding point of the year's meteorological circle. On May 5 sun's declination is 16°.2 N. Atmospheric temperature 49°.46:—Daily increment 0°.17[a]. Dew-point 41°.19[b]:—Daily increment 0°.24[c]:—Difference 8°.27[d]. Atmospheric pressure 29.931[e] in.; near the conclusion of a nineteen days period of diminishing values. Air pressure 29.6687[f] in. Vapour pressure 0.2587[g] in.; increasing:—Weight of vapour in cubic foot of atmosphere 2.69[h] gr. Humidity 73.4[i]; increasing. Rain 0.080[j] in.; near a casual maximum. Rainy days $\frac{8.3}{16}$[k]; increasing. Cloudy days $\frac{7.7}{16}$[l]; increasing. Daily change 0.1382[m]; increasing.

0.13[a]
43.1[b]
0.12[c]
6.3[d]
29.970[e]
29.693[f]
.2775[g]
3.24[h]
78.6[i]
.090[j]
8.6[k]
9.1[l]
.159[m]

SECTION V.

Sect. V.
May 19—June 18.

Sun's Decl.
19°.7 N.—23°.4 N.

Section V. includes 31 days;—commencing May 19 and terminating June 18.

The Sun's Declination is 19°.7 N. on the first day, and 23°.4 N. on the last day: his position in the Ecliptic is not much altered during the whole Section. The position however is peculiar: the area of land that is brought under his vertical rays is greater than in any other Section except the next: the parallel corresponding with the sun's declination is one—especially at the close of the Section—just intervening between a most extensive land area on the North which is heated by his nearly vertical rays, and a still extensive sea area on the South which yields vapour copiously to the atmosphere: on one side of the globe there is all the continent of Asia on the

SECT. V.
May 19—June 18.
Sun's Decl.
19°7. N.—23°4. N.

north side of the line, and the Indian Ocean on the south side: on the other side of the globe there is N. America to the North, whilst to the South as far as to the Equator there is only a contracted portion of S. America encroaching on the N. Atlantic and N. Pacific Oceans. From the great extent of the land area it might be expected that this and the succeeding Section would constitute the dry season for the world at large, and more especially for that portion of the world which is North of the sun's position, though that which is immediately beneath and to the South of him may have rain in excess: the tendency would be for the superincumbent atmosphere of the land district to be greatly heated, and for that of the sea district to be loaded with vapour: it is the former that most concerns the N. Temperate Zone.

The Atmospheric Temperature for the first and last days is, 49.4 respectively, 52°.8 and 58°.0,—giving a mean daily increment which is 0°.02 below that of the preceding Section, and 0°.04 above the .13 total mean: on the first day the value for this is as high as 0°.27.

The Dew-point Temperature on the first and last days is 45°.0 43.1 and 49°.8; so that the rate of increment falls a little below that of the atmospheric temperature, and is 0°.05 less than the value for the 0.12 preceding Section, and 0°.04 above the total mean. The difference between the two temperatures is great—the preceding Section alone, giving a higher value.* [1]

The Atmospheric Pressure is in excess as compared with the 29.970 annual mean by .016 in.: and as compared with the preceding + .016[a] Section by .037. The daily values undergo but little alteration,—the greatest change for any one day being a rise of .011, on May 27: the whole range—*i. e.* the difference between highest and lowest value—during the Section is .101.

The Air Pressure is less than in the preceding Section by .033 — .036[a] in., and less than the annual mean by .036.

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* The marked diminution in the increment of the dew-point temperature exhibited by the diagram towards the end of May—whilst the atmospheric temperature rises with increased rapidity, is synchronous with the sun reaching the southern boundaries of Asia and North America. The subsequent rapid rise in the dew-point would appear to depend upon the prolonged action of the sun's vertical rays upon the Atlantic.

[1] See diagram for Section V.

The Vapour Pressure is .070 in. in excess of the preceding Section, and .051 in excess of the annual mean. $+.051^{a}$

The Humidity has a value 1.5 higher than in the preceding Section, and 3.7 lower than the annual mean. -3.7^{a}

The Fall of Rain—looking to the mean daily amount—is just below the value for the preceding Section, and is .019 below the annual mean. .090

The Rainy Days are 0.5 less numerous than in the preceding Section, and below the annual mean by 0.8, and they diminish in their numbers in the course of the Section. $\frac{8.6}{16}$

The Cloudy Days have a value a trifle below that of the preceding Section, and 1.6 below the annual mean. $\frac{9.1}{16}$

The Daily Change in the atmospheric pressure is .014 in. less than for the preceding Section, and .033 less than the annual mean. .159

A large quantity of vapour is mixed with the atmosphere during this Section, at the site of observation, but it scarcely exceeds what is due to the elevated temperature of the atmosphere: the atmosphere over the extensive plains of Central Asia and Europe is hot and dry enough, as it appears, to absorb the vapour; the sky is consequently kept clear and any considerable deposition precluded at the site of observation. The rains are, however, very heavy at this period of the year in the northern latitudes of the Torrid Zone, and probably but a small proportion of the vapour produced in the Torrid Zone is transferred to the North Temperate Zone whilst the Sun has a high N. declination.

SECTION VI.

Sect. VI.
June 19—July 20.

Sun's Decl.
23°.4 N.—20°.7 N.

Section VI. includes 32 days;—commencing with June 19, and terminating with July 20.

The Sun's Declination on the terminal days is 23°.4 N., and 20°.7 N.: the whole range of declination is only 2°.7;—the max. declination being 23°.45: the range is less than occurs in any other Section: the sun's position differs but little from what it was in the preceding Section, but the peculiarities of the position are slightly aggravated in this.

SECT. VI.
June 19—July 20.

Sun's Decl.
23°.4 N.—20°.7 N.

The Atmospheric Temperature on the first and last days is 58°.2 and 60°.6—showing a rate of increment of 0°.08 only per diem. For a few days (July 13-16) the temperature may be considered to be stationary: probably in some (even long) series of years there may be a retrograde movement at this time.

The Dew-point Temperature rises at the rate of 0°.11 per diem. The daily increment in this particular continues, though the rate progressively declines, until the max. value for the year is attained;—this contrasts with the progression of atmospheric temperature, and the result is that the difference between the two temperatures attains a casual min. value on July 19,—the atmospheric temperature now rising at an increasing rate. The marked difference in the progress of the two temperatures[1] implies that there is a less abatement in the increment of temperature in the South-West, whence the vapour proceeds,—*viz.*, the Atlantic—than at the site of observation, and possibly, if it were not for the influx of warm vapour, the max. temperature would occur about the 14th July, but owing to this influx the temperature continues to rise until August 3; and this second rise seems to correspond to the second fall of temperature which occurs in the course of the first Section: nineteen days intervene between the primary and the secondary maximum. These double extremes both of high and of low temperature admit of being viewed under two aspects: the retrogade movement which intervenes between each pair of extremes may be regarded as out of date and more or less accidental;—or one of each pair of extremes may be regarded as accidental or contingent upon local peculiarities; the first view seems to apply to both cases; because, in each the retrograde movement is associated with a direction of wind which is out of season;—all through July the N.W. wind prevails with more than its average frequency, and attains a max. value on the 11th, and the S.W. attains a min. value on the same date; but still, the S.W. preponderates considerably: the rise of temperature in January is accompanied with a preponderating S.W. wind which acquires a max. value two days after the max. rate of increment of temperature: the rise in the atmospheric and dew-point temperatures until August 3 is probably normal and constant; because, first, the

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[1] See Diagram for Section VI.

Sect. VI.
June 19—July 20.

Sun's Decl.
23°.4 N.—20°.7 N.

dew-point temperature is less checked than the atmospheric,—by which it appears that the tendency is strong, and extensive, to an increase of vapour and temperature; secondly, the max. temperature seems to show that it observes its proper date, by its coincidence with the pole of high temperature. The decline of temperature until so late a date as February 11 is probably in some measure abnormal, because the date does not coincide with that of the pole of low temperature; and the preceding retrograde movement is probably also in some measure abnormal or peculiar to a very limited locality, because the rise in the dew-point temperature is by no means equal to that in the atmospheric temperature,—the amount of vapour being diffused over a more extensive neighbourhood than the temperature is, and consequently not so much dependent upon local peculiarities. The dew-point values for the terminal days of the Section are 50°.0, and 53°.4. The difference between the two temperatures is 0°.5 less than for the preceding Section.

43 /

The Atmospheric Pressure continues to augment,—the value for this Section being .008 in. in excess of that for the preceding Section, and .023 above the annual mean. The amount of the pressure is even more constant in this than in the preceding Section: the whole range is only .031 in.; and the greatest variation for any one day is .005; and during the period June 28—July 12 the variation never reaches .0015. The max. pressure for the Section is on July 4, and the diminution of pressure is, after this, such as to reduce the value for the last day .008 below that for the first.

The Air Pressure continues to decline,—the value for this Section being .053 in. below that for the preceding one; and the value for the last day is .056 below that for the first.

The Vapour Pressure continues to increase,—the value for this Section being .060 in. in excess of that for the preceding Section.

The Humidity exceeds that of the preceding Section by 1.1,—showing the great increment of vapour as compared with that of temperature.

The Fall of Rain is very small,—the third Section being the only one that gives so low a value: the lowest value in the Section occurs on July 8.

The Rainy Days are more numerous in this Section than in the preceding by 0.1; and the values increase as the dates advance.

Sect. VI.
June 19—July 20.
Sun's Decl.
23°.4 N.—20°.7 N.

The Cloudy Days are more numerous than in the preceding Section by 0.6; and the values here also increase as the Section advances, and at a somewhat more rapid rate than the Rainy days do.

The Daily Change in the atmospheric pressure is only .123,—Section VIII. alone giving so low a value.

The atmosphere is charged with a large proportion of vapour during this Section, and there is consequently an observable augmentation of condensation in the upper strata: but there has been no decrement of temperature as yet to reverse the balance as between vaporisation and deposition at the site of observation; and there is no indication of such reversal occurring elsewhere, unless it be in the diminishing pressure of the atmosphere during the latter half of the Section; and this is more fairly attributable to the tendency in the atmosphere to recover its proper level,—the depreciation being very gradual, and the value for the last day being still .002 in excess of the annual mean.

SECTION VII.

Sect. VII.
July 21—Aug. 19.
Sun's Decl.
20°.5 N.—12°.9 N.

Section VII. embraces the 30 days of highest atmospheric temperature;—the first day being July 21, the last August 19.

The Sun's Declination is 20°.5 N. for the first day; 12°.9 N. for the last day: this range of latitude includes within it the greatest width of Africa and Arabia, the whole peninsula of Hindostan, and the peninsula of Siam; but, on the other hand it includes scarcely any land in America, and does include the Arabian Sea, the Bay of Bengal, and the Chinese Sea: thus there is a decided gain as to vapour yielding sea, and some loss as to the land area,—comparing this Section with the preceding. It might be expected that the *increment* of vapour would now be more conspicuous than the decrement of Temperature.

1.3[a] **The Atmospheric Temperature** has a mean value only 1°.3
above that of the preceding Section:—but on the 3rd August the
61.37 atmospheric temperature attains its max. value for the year, *viz.*,
1.59[b] 61°.37, and this day gives an excess 1°.59: the subsequent decre-
.75[c] ment to the end of the Section amounts to 0°.75,—equivalent to the
.05[d] rate 0°.05 per diem; the daily decrement amounts to as much as

SECT. VII.
July 21—Aug 19.

Sun's Decl.
20°.5 N.—12°.9 N.

0°.06 on the 12th, and 0°.07 on the 16th. The rise in the sun thermometer on August 3 is 94 per cent. of its whole annual range.

If we adopt Aug. 3 and Feb. 11 as the dates of the two poles of temperature; then, there are 192 days occupied in reducing the temperature from maximum to minimum, and there are 173 occupied in raising it from minimum to maximum;—but if we adopt July 14 and January 4 for the poles,—these being the dates of the preliminary maximum and minimum,—we then have 174 days occupied in the decrement, and 191 in the increment. There are 169 days above mean temperature, and 194 below the mean. When the min. temperature has been attained the thermometer rises 1°.04 during the ten succeeding days; but when the max. temperature has been attained the fall is only 0°.36 in the ten days.

The Dew-point Temperature is 1°.4 in excess of that for the 1.4[a]
preceding Section, and the excess for August 2—day of max. dew-
point—is 1°.64: the decrement for the interval August 2—19, is 1.64[b]
1°.06, giving a rate of 0°.06 per diem: the daily decrement amounts 1.06[c]
to 0°.07 on the 11th, and 0°.10 on the 15th: the dew-point temper- .06[d]
ature for August 2 is 53°.73. The difference between the two 53.7
temperatures is on the whole Section 0°.1 less than for the preceding — .1[e]
Section; but on the last day it is 0°.26 greater. + .26

The Atmospheric Pressure falls below that for the preceding
Section by .027 in., and a trifle below that for the year: during the — .027[a]
six first days of the Section the pressure is nearly stationary,—the
value for July 27 being .005 above that for the first day;* there is
then a return to the slow falling movement that was observed during
the latter half of the preceding Section:—a value is thus attained
on August 6, .030 below that of the first day, and .028 below the — .030[c]
annual mean: after this the pressure undergoes a protracted daily
increment, which extends beyond the limit of the Section, and gives
a value to the last day .018 in excess of the first. + .018[f]

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* The atmospheric pressure may be considered virtually to undergo *very* slow decrement from July 5 unto August 6;—the exception is very trifling, and probably accidental: if the daily values be subjected to another pair of decadal reductions, they then exhibit a daily decrement from July 6 unto August 6, which on three days only amounts to so much as .003.

$-.048^{a}$ **The Air Pressure** has a mean value .048 in. below that for the
preceding Section: during the first few days there is a small increase
in this pressure also,—the value for July 27 being .002 in excess of
that for the first day; subsidence then ensues, and on August 6 the
$-.034^{e}$ pressure is .034 less than on the first day: on the last day the value
$+.029^{f}$ is .029 in excess of the first.

$+.021^{a}$ **The Vapour Pressure** is .021 in. in excess of the value for the
preceding Section, and it also exceeds that for any other of the
twenty-four divisions; the mean value for the Section being .410:
there is a small increase in this pressure, also, at first; .003 being
the excess for the 27th over the first day: on Aug 3 the pressure is
$+.004^{e}$ .004 more than on the first day; the value for this day is .4135,—
.414 the maximum for the year: on the last day it is .011 less than on
$-.011^{f}$ the first. On August 3 there are 4.59 gr. of vapour in the cubic
4.59 foot,—the max. value for the year: 4.58 gr. is the mean value for
the Section.

The Humidity increases from the fourth Section to the seventh,
—including the seventh—but still in this Section it is 2.0 below the
78.6 annual mean: on July 27 a casual max. value is attained of 77.2:
on August 6 the value is 2.7 less than on July 27, and on the last
day it is 2.2 less than on July 27.

The Fall of Rain exceeds in its daily mean each of the preceding Sections, and is in defect as compared with the 9th, 10th,
11th and 12th Sections: it is also in defect as compared with the
.090 annual mean by .007 in. The mean value for the Section being
$+.017^{a}$ .083, this exceeds the value for the preceding Section by .017: the
quantity on the first day is .081; from this day the quantities
diminish slightly until July 28, and then slowly increase until
$+.006^{e}$ August 13, giving an excess of .006 on August 6 over the first day:
after this the values augment considerably, amounting to a casual
$+.024^{f}$ maximum of .105 on August 20, which is .024 above the quantity
for the first day.

It appears from the statement now given that during this Section of maximum—and consequently of equable—temperature the atmosphere remains in a very quiescent state: the quantity of vapour gradually accumulates until it reaches the saturation point, or else (and this seems to be the more probable condition) saturation is effected through the agency of a slight decline of temperature in

SECT. VII.
July 21—Aug. 19.
Sun's Decl.
20°.5 N.—12°.9 N.

the upper strata of the atmosphere.* On July 30,—thirty-nine days after the sun attains his highest declination, and sixteen days after the preliminary max. temperature—the fall of rain begins to increase, and seeing that (with a trifling exception) the atmospheric pressure had been declining slowly from an early date in July, it is probable that the fall of rain had for some time previously set in with some energy in some neighbouring locality—perhaps the North of England. In proportion as the fall of rain increases at the site of observation, it balances, and, as the temperature declines, overbalances that of the northern districts;—decrement is exchanged for increment in the atmospheric pressure,—increment for decrement in the vapour pressure,—and the humidity also diminishes in its value.

The Rainy Days are considerably more numerous than in the preceding Section: the highest values occur at the period when it may be supposed that the fall of rain in the South of the country balances that in the North, *viz.*, Aug. 6-8, the value being 9.5 on these three days.

The Cloudy Days are also more numerous than in the preceding Section: the highest values occur at the commencement of the Section ,when it may be supposed that the fall of rain is proceeding with some energy and constancy in the North: the max. value is 9.3, and this occurs on each of the three first days.

The Daily Change of atmospheric pressure is slightly in excess of what occurs in the preceding Section, and is .032 in. below the annual mean: the values constantly increase from July 26 to the end of the Section.

.159

The southerly currents have greatly the preponderance over the northerly in this and the two preceding Sections.

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* It appears probable that the decrement of temperature in the higher strata of the atmosphere is in advance of that in the lower strata, as the rain that descends in the fall of the year is found to have a lower temperature than the atmosphere. Experiments carried on during one year had the result of showing, that the rain had a higher temperature than the atmosphere in the period April 3—July 7, by the mean value 0°.78; and a lower temperature in the period Sept. 28—Dec. 12, by the mean value 0°.61.

Sect. VIII.
Aug. 20—Sept. 12.

Sun's Decl.
$12^\circ.5$ N.—$4^\circ.3$ N.

SECTION VIII.

Section VIII. includes 24 days:—the first day being August 20, the last September 12.

The Sun's Declination on the terminal days of the Section is, respectively, $12^\circ.5$ N. and $4^\circ.3$ N.: his progress towards the South is now considerable. The sun in the course of this Section traverses those seas whose boundaries he reached at the conclusion of the seventh Section, *viz.*, the Caribbean Sea, the Arabian Sea, the Bay of Bengal and the Chinese Sea: the continent of Asia may be said to be exchanged for the Indian Ocean as the area receiving the strong influence of his rays: it is not, however, the sea placed under his vertical rays that is the principal source of the vapour supplied to the Temperate Zone—the vapour produced in the Torrid Zone being for the most part precipitated in the Torrid Zone; whilst the sun is approaching the Equator the tendency in the atmosphere under his vertical rays to flow beyond the line of the tropic diminishes: in the first place, the line of the Equator being that where the atmosphere has the strongest tendency to remain in the same latitude, this becomes the region of most abundant vapour; and in the next place, the high temperature which yet exists north of the sun's position weakens the tendency there to draw the atmosphere from the central latitudes,—the continuance of high temperature having an influence differing from that which results from either an increasing or a decreasing temperature, the former withdraws the vapour from the region of its supply by affording it accommodation, the latter does the same thing, but more rapidly, by withdrawing the vapour from the atmosphere and putting the atmosphere itself into motion from the region of supply to that of deposition.

The Atmospheric Temperature falls but little below that of the preceding Section,—only $1^\circ.65$. The values for the first and last days are $60^\circ.6$, and $58^\circ.1$;—giving a mean daily decrement $0^\circ.1$: the temperature of the last day is only $3^\circ.3$ lower than max. temperature.

.12

The Dew-point Temperature is also in defect of the preceding Section, and to a greater amount than the atmospheric temperature is,—the defect here being $2^\circ.1$: the decrement during the Section, however, is not so great,—amounting to $2^\circ.1$: the daily rate is so

Sect. VIII.
Aug. 20—Sept. 12.

Sun's Decl.
12°5 N.—4°.3 N.

much as 0°.13 for the three last days of August, and this is reduced to a low min. value on the last day. From August 10 to August 29 the decrement in the dew-point is on each day greater than in the atmospheric temperature,—implying that the decrement in the latter is greater in the upper strata of atmosphere than in the lower where the thermometer is read: but the decrement of the atmospheric temperature then obtains the preponderance, and on the last day of the Section, the dew-point value being 0°.03, that for the atmosphere is 0°.10. The direction of the wind having been S.W. to the end of August, it shifts to the N.E. on Sept. 1 and remains in that quarter till the 15th. The difference between the two temperatures for the Section is 0°.4 less than for the preceding Section: these values diminish daily from September 1 to December 5, notwithstanding the direction of the wind during the first fortnight of this period.

.10

The Atmospheric Pressure has a higher value for this Section than for any other of the twenty-four divisions: it exceeds the annual mean by .120 in. A series of increasing values which commenced towards the latter end of the preceding Section continues unto September 3,—the first of the series occurring four days subsequent to the date of max. temperature; the value 30.143 in. is attained on September 3, which is the max. value for the year, and .173 above the annual mean. After September 3 a long series of declining values ensues which terminates with the min. value for the year on October 4, in the succeeding Section, although the direction of the wind is N.E. until September 15.

29.970

30.143

The Air Pressure has also a high value for this Section: it is .155 in. above that for the preceding Section, and .019 above the annual mean. This pressure augments and declines simultaneously with that of the atmospheric pressure,—attaining a *casual* maximum on September 3 of 29.769.

29.693

The Vapour Pressure which began to decline directly after the date of max. temperature (August 3, 4,) continues to decline unto October 4 and beyond this date,—but does not fall below the annual mean until November 1: on the last day of the Section it is .0896 in. in excess of the annual mean. The value for the Section is .031 below that for the preceding Section.

.2773

The Humidity is below that for the preceding Section by 2.6,—owing to the decrement of vapour; but on the last day it is 0.5

SECT. VIII.
Aug. 20—Sept. 12.

Sun's Decl.
12°.5 N.—4°.3 N.

above the value for September 3, owing to the decrement of temperature.

The particulars above stated, taken together, would make it appear that the atmosphere must have been under the influence of an extensive condensation and copious deposition of its aqueous constituent; but this has not in fact occurred at the site of observation, —the season for this has not yet arrived, though it is approaching.

The Fall of Rain is on the average only .006 in. per diem greater in this Section than in the preceding. The daily value for the Section being .077, that for September 3 is .061, and that for the
.090 last day .066; the Fall, which is not great at any period of the Section and is at a casual maximum on the first day when the atmospheric pressure is steadily increasing, is small during the latter part of the Section when the pressure is subsiding.

The Rainy Days are less numerous in this Section than in any other of the twenty-four divisions, and the mean value is 1.9 less
8.6/16 than the annual mean;—a fact which makes it appear that the deposition causing the changes observed must be at a considerable distance from the site of observation. The least frequently rainy
5.6 day in the year is September 11,—the value for this date being 5.6: the values diminish progressively and slowly throughout the Section.

The Cloudy Days are also less numerous in this Section than in any other of the twenty four divisions; the value for the Section
9.1/16 being 2.1 below the annual mean. The least frequently cloudy day
6.0 in the year is September 4,—the value for this date being 6.0.

The Daily Change of atmospheric pressure is less for this Section than for any other of the twenty-four divisions,—making it appear that there is some one action steadily and constantly maintained:
.159 the mean value for the Section is .045 in. below the annual mean;
.105 the highest value is .136, on the first day: the min. value for the year .105, in this particular also, falls on September 4.

The phenomena observed and the particulars now detailed mark this Section as one of critical change and importance. The 3rd September may be pointed to as the culminating date of the crisis, or as the turning point between two opposite meteorological conditions, as regards some considerable portion of the globe: the site of observation however is not included in this portion; the crisis occurs there a month later in the year, and in the course of the

Sect. VIII.
Aug. 20—Sept. 12.
Sun's Decl.
12°.5 N.—4°.3 N.

following Section: the mean date of the crisis or that which belongs to the northern hemisphere may probably be about mid-way in the month's interval, which will nearly coincide with the date of the Equinox: the 4th September, it may be observed, is the day on which the sun thermometer attains its max. value. The isothermal line which passes along the English Channel has the summit of its curve in the Channel, which indicates this to be the locality of one of the two extremes, or at least leads to the presumption that here the crisis would be late in making its appearance. It may be assumed with tolerable security that on September 3 a considerable decrement of temperature has occurred in the central parts of Europe and Asia, although this decrement has not been great at the site of observation*: on the 4th September the sun thermometer attains its max. reading, though the atmosphere thermometer has fallen 10 per cent. of its annual range. It may easily be credited that the almost saturated atmosphere in the neighbourhood of the site of observation would be drawn as an upper warm current to those districts where the temperature had fallen much more rapidly, and where the temperature was also much lower; and this upper current would then be balanced by an under current of cold dry air from these districts to the site of observation. Now it is the fact that S.W. winds having prevailed from May 10 to August 31, N.E. winds set in on September 1 and prevail for a fortnight; and the S.E. winds

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* This is rendered probable by some of the particulars contained in Dr. Prout's Tables relating to isothermal lines, in his Bridgewater Treatise: there is no locality noticed in these Tables having more than 21° E. longitude and placed between 47° and 52° N. latitude: between these parallels and to the westward of this meridian are six stations; these are represented as having a mean autumn temperature 18° below their summer temperature: the difference at Newport in this respect is only 9°; that at Greenwich for the same sixteen years as enter into the calculation for Newport is 11°;—that for London as given in Dr. Prout's Tables is 13°. The summer temperature at Newport is 60°, and the autumn temperature 51°; and the latter value falls on October 15:—but 60 − 18 = 42, and 42° is the Newport temperature for December 10: so that on this last date we experience the same decrement of temperature at the site of observation, as occurs at the stations referred to, at the date of their mean autumn temperature;—making the difference of nearly two months, as to the rapidity of decrement.

Sect. VIII.
Aug. 20—Sept. 12.

Sun's Decl.
12°.5 N.—4°.3 N.

exceed their mean annual value for prevalence all through September.* The abundant vapour brought to the cold districts would be precipitated there in plentiful rain: in proportion as the precipitation continued and increased would the current of vapour acquire force, and this current, as it acquired force, would carry the other constituents of the atmosphere along with it. The current is here dependent upon two concurring principles, *viz.*, the agency of diversity of temperature, and the constant loss sustained by one of the ingredients of the atmosphere;—one result of this being an influx of dry though comparatively cold atmosphere at the site of observation in exchange for its own warm atmosphere loaded with a large quantity of vapour. The English Channel is likely to be a centre of action in these changes—and the Isle of Wight, perhaps, the very focus: the peculiar influence of the Atlantic atmosphere in delaying the decrement of temperature, and in charging the atmosphere with vapour, would probably not reach its maximum anywhere short of this point: and both north and east of it the substitution of land for sea would preclude its continued augmentation: the N.E. and easterly currents would consequently not proceed far beyond this mark probably;—in the course of the Channel, or at its mouth at the furthest, it would be met and overpowered by the S.W. current; and then an accumulation of atmosphere would ensue and cause a high reading of the barometer.

The hypothesis here ventured upon seems to be supported by adequate evidence, as it will serve to account for the clear sky and absence of rain, as well as for all the other peculiarities of the season, which are so marked at the site of observation although cloud and rain had previously commenced augmenting: the diminution in the

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* The N.E. winds exceed their mean annual value from Aug. 29 to 17 Sept.
S.E. .... Aug. 31 — 1 Oct.
The N.E. winds commence increasing their values on Aug. 21
S.E. .... Aug. 25
The N.E. winds continue their increase unto .... 6 Sept.
S.E. .... 13 Sept.

From this it appears that the rain commences in the N.E., and then progresses or extends to the S.E., in proportion as the decrement of temperature progresses towards the South.

Sect. VIII.
Aug. 20—Sept. 12.
Sun's Decl.
12°.5 N.—4°.3 N.

vapour pressure, which becomes marked in the middle of August, and the diminution in the fall of rain which commences soon after, are significant and early indications of what is going on.

SECTION IX.

Sect. IX.
Sept. 13—Oct. 6.
Sun's Decl.
4°.0 N.—5°.0 S.

Section IX. includes the period of critical change at the site of observation: the decrement of temperature and the precipitation of water from the atmosphere proceed with great energy. The sun crosses the Equator about the middle period of the Section. There are 24 days included in this Section;—the first day being September 13, and the last October 6.

The Sun's Declination on the terminal days is, respectively, 4° N., and 5° S. This range brings the north part of S. America directly beneath the sun, but the gain of land area here is more than counterbalanced by what is lost in Africa, and a great accession of sea area is obtained in the Indian Ocean. As the sun's position in this Section may be said to be on the Equator, there is, probably, not any great quantity of vapour transferred from the Torrid Zone to the Temperate; but the warmth of the sea itself in the Temperate Zone will maintain a large supply, and as the S.W. winds (those from the Atlantic, that is to say) again prevail on September 16, and continue to do so unto November 23, the full benefit of this supply will be experienced at the site of observation; and accordingly, the amount of vapour in the atmosphere in this Section is great, considering the amount precipitated during the Section in the form of rain—as tested by the rain-guage.

The Atmospheric Temperature for this Section is 3°.7 lower than that for the preceding Section. The last day has a value 4°.7 below that for the first,—giving a rate of decrement 0°.21 per diem, and this increases to 0°.24 on the last day. The temperature on September 23 (date of the equinox) is 56°.1,—that at the date of the vernal equinox being 42°.3. On October 3 (date of max. deposition) the atmosphere thermometer has fallen 33 per cent. of the annual range, the sun thermometer falling 37 per cent.: on September 23

SECT. IX.
Sept. 13—Oct. 6.

Sun's Decl.
4°.0 N.—5°.0 S.

the atmosphere thermometer having fallen 23.3 per cent., the sun thermometer has fallen 22.2 per cent.

.10

The Dew-point Temperature steadily declines all through the Section at a mean rate of 0°.12 per diem, which increases to 0°.19 on the last day. The difference between the two temperatures diminishes daily throughout the Section: the difference on September 23 is 6°.7; on March 21 it is 7°.0.

29.970
30.143
29.821
$-.150^{a}$
$-.322^{b}$
$-.068^{c}$
$-.254^{d}$
$+.005^{e}$

The Atmospheric Pressure having attained its max. value for the year on September 3, then undergoes a daily decrement during thirty-one days,—attaining on October 4 the min. value for the year, *viz.*, 29.821 in., which is .150 below the annual mean, and .322 below the maximum of September 3. On the first day of this Section the pressure is .0685 less than on September 3,—equivalent to .0069 per diem: on October 4 the pressure is .254 less than on September 13,—the rate of decrement for this period being .0121 per diem: on October 6 the pressure is .005 more than on the 4th. The mean pressure for the Section is .1585 below that for the preceding Section, and .0385 below the annual mean.

$-.209^{a}$
$-.285^{b}$
$-.061^{c}$
$-.224^{d}$
$+.010^{e}$

The Air Pressure is .131 in. below that for the preceding Section; the value is the same as for October, and neither of the other 22 divisions gives so low a value. This pressure observes the same *periods* of increment and decrement as the atmospheric pressure does, from September 1 to October 6. On October 4 this pressure is .209 below the annual mean, and .285 below the value for September 3; on September 13 it is .061 less than on the 3rd: on October 4 it is .224 less than on September 13: on October 6 it is .010 greater than on the 4th.

$+.0592^{a}$
$-.0374^{b}$
-0073^{c}
$-.0301^{d}$
$-.0051^{e}$

The Vapour Pressure is .028 in. less for this Section than for the preceding one: it is .0035 less on September 3 than on September 1: on October 4 this pressure is .0592 greater than the annual mean, and .0374 less than on September 3: on September 13 it is .0073 less than on the 3rd: on October 4 it is .0301 less than on September 13: on October 6 it is .0051 less than on the 4th.

$+3.1^{a}$
$+7.5^{b}$
$+2.0^{c}$
$+4.5^{d}$
-0.9^{e}

The Humidity has a value for September 3, 0.5 greater than for the 1st: that for October 4 is 3.1 higher than the annual mean; and 7.5 higher than that for September 3: that for September 13 is 2.0 higher than the 3rd: that for October 4 is 4.5 higher than September 13: that for October 6 is 0.9 less than the 4th,—but on the 7th it is 0.9 higher again than on the 6th.

Sect. IX.
Sept. 13—Oct. 6.

Sun's Decl.
4°.0 N.—5°.0 S.

+ .106 [a]
+ .135 [b]
+ .006 [c]
+ .129 [d]
− .009 [e]
.197

The Fall of Rain has a value which is exceeded by that for the 10th Section only, and which exceeds that for the preceding Section by .057 in.: the value on September 3 is .002 less than on the 1st: that on October 4 is .106 greater than the annual mean; and .135 greater than that on September 3: on September 13 it is .006 greater than on the 3rd: on October 4 it is .129 greater than on September 13: on October 6 it is .009 less than on the 4th. The greatest amount for any one day in the year is .197, on October 3; which is .107 in excess of the annual mean.

The Rainy Days just exceed the annual mean value, and they exceed the value for the preceding Section by 2.0: the most frequently rainy day in the year is October 4,—the value for this day being 10.8; which exceeds the annual mean by 2.2.

10.8

The Cloudy Days have a value a little below the annual mean; they exceed the value for the preceding Section by 1.6.

The Daily Change in the atmospheric pressure has a value below the annual mean, and .034 in. above that for the preceding Section. The values diminish from September 1 to September 4: they then increase daily to the last day of the Section, attaining on that day a casual maximum which is .012 in excess of the annual mean.

.159

The occurrences which characterise this Section are supposed to be the result of decrement of temperature, and consequent profuse precipitation from the atmosphere. But the rain collected, although abundant, is not proportionate to the other phenomena, and the quantity is not equal to what it comes to be in the succeeding Section: moreover the precipitation, though great, leaves an amount of vapour in the atmosphere which is even more excessive:—if the whole range of the vapour pressure, and of the fall of rain, from the lowest to the highest daily values, be divided into ten equal parts,—the vapour pressure for the Section then exceeds the annual mean value by 3.3 of these parts, and the fall of rain exceeds the annual mean by 2.8 of these parts.* The decrement of temperature

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* The average annual fall of rain is 33 inches, and the greatest quantity that has fallen in any one year out of the sixteen is 47.6 inches: the annual average at Greenwich for the same sixteen years is 24 inches; so that proximity to the principal source of the vapour appears to be attended with more abundant *habitual* precipitation; but if we look to the effect of *decrement of temperature* in producing precipitation, it is probable that this is more marked in the more inland localities.

SECT. IX.
Sept. 13—Oct. 6.

Sun's Decl.
4°.0 N.—5°.0 S.

and the consequent increased fall of rain at the site of observation, seem pretty certain to be less than they would be in the surrounding and neighbouring inland localities, and it is the precipitation in the neighbourhood that is to be regarded as the more efficient agent in producing the phenomena detailed: the site of observation participates in the general reduction of temperature but retains a large proportionate amount of vapour in its atmosphere, and the humidity consequently increases from September 1 to October 6. Profuse precipitation at a distance is supposed to be the immediate cause of phenomena which occur in the 8th Section and culminate on September 3: the approach to, and partial arrival at, the site of observation of profuse precipitation, is the immediate cause of phenomena of an opposite character which occur in this the 9th Section, and culminate on October 4. The extension, and the approach, of the site of precipitation is marked by the increasing values acquired by the daily change of atmospheric pressure,—this augmentation going on from September 4 to the end of this Section.

Some of the particulars which have been stated above may be advantageously collated in the following tabulated form.

Table showing the movements of the several atmospheric constituents.

	At. Press.	Air Press.	Vap. Pres.	Hum.	Rain.	
Values for October 4	−.150	−.209	+.0592	+3.1	+.106	As compared with annual mean.
,, October 4	−.322	−.285	−.0374	+7.5	+.135	,, ,, ,, September 3
,, Sept. 13	−.068	−.061	−.0073	+2.0	+.006	,, ,, ,, September 3
,, October 4	−.254	−.224	−.0301	+4.5	+.129	,, ,, ,, September 13
,, October 6	+.005	+.010	−.0051	−0.9	−.009	,, ,, ,, October 4

The defect in the air pressure in the above Table is remarkable, and is accountable for by the general supposition that the principal deposition occurs on the circumference of a circular area of which the site of observation may be regarded as the centre. Some light may be thrown on this part of the subject by a reference to the force of the wind. On September 3 (date on which the effects of distant deposition are at their maximum) the force of the wind is 0.24

2.23

Max. force.
2.78

Min. force.
1.30

above the annual mean, the N.E. having had sufficient strength to overpower the S.W. on September 1, and it thus occasions great accumulation of air: previously to this,—August 25-30—whilst the S.W. wind still retained the ascendancy, the force was so much as 0.48 above the annual mean, and during these 6 days of resistance to the N.E. beyond the site of observation, the increment of air pressure proceeds at the rate of .016 per diem. But the N.E. is, in turn, first checked and then overpowered by the S.W.,—the S.W. regains possession of the field on September 14, and on the 13th, when the two powers are evenly balanced, the force of the wind subsides to a casual minimum of 1.73: on the 13th the air pressure is declining, but only to a small extent; the decrement being only half that of the vapour pressure since the 3rd, and it still—under the converging currents—remains .015 above annual mean. The S.W. having fairly gained the ascendancy, the force of wind augments again; a thorough draught is established, and on September 27 it has acquired a force 0.23 above annual mean; and the decrement of air pressure from the 24th to the 28th is at the rate .014 per diem. On October 4 the deposition at the centre becoming equal to that at the circumference, the force of wind subsides to par, and the decrease of air pressure subsides to the rate .007 per diem from the 28th September. On October 4 the centre of the circle having become the site of max. deposition, the atmosphere converges to this point: on the 6th the force of wind has lost 0.12, and the air pressure gains .010, whilst the vapour pressure loses .0051. The notable facts here are, that the quantity of air *relatively* to that of the other ingredient of the atmosphere is dependent upon the supply and consumption of the vapour,—that the increment and decrement of the air in relation to *time* is simultaneous with the confluent and effluent direction of the atmospheric current, —that the *rate* of increment and decrement are in proportion to the rapidity of the current.

SECTION X.

Sect. X.
Oct. 7—Nov. 5.

Sun's Decl.
5°.4 S.—15°.6 S.

Section X. embraces the 30 days in the fall of the year, the mean temperature of which comes nearest to the mean value for the

Sect. X.
Oct. 7—Nov. 5.

Sun's Decl.
5°.4 S.—15°.6 S.

year. The terminal dates are October 7, and November 5. This is a Section of extensive change, the preceding Section being one of critical change.

The Sun's Declination on the terminal days is respectively 5°.4 S., and 15°.6 S. The sun makes a somewhat greater advance in the Ecliptic in this Section than he does in any other,—but the daily progress for Sections II. and III. is somewhat greater than for this; the rate for Section II. is 0°.4 per diem, and for this it is 0°.35. The proportion of land to sea area brought under the sun's vertical rays, remains much the same during this Section as it was at the termination of the last, but he recedes further from an extensive land area, and approaches nearer to an extensive sea area. On the north side of the northern tropic the sun's rays now fall too obliquely to have much effect in raising vapour from the sea: but on the south side of this tropic the land contracts, and the sea surface expands, towards the South, and this in some measure serves to counterbalance the defect that might otherwise arise.

The Atmospheric Temperature has a value for this Section 6°.4 below that for the preceding Section. The values for the first and
.12 last days being 53°, and 46°.6: this gives a rate of decrement amounting to 0°.22 per diem, which exceeds the daily rate of change for any other of the Sections, but October gives the rate 0°.23: the
.30 max. change for any one day is 0°.30, on October 12. The annual
49.4 mean temperature occurs on October 20,—twenty-seven days after the date of the equinox: the sun's declination on October 20 is 10°.3 S. The annual mean occurs in the Spring on May 5,—forty-five days after the date of the equinox: the sun's declination on this day is 16°.2 N. The mean value for the sun thermometer occurs on April 25 and October 21: on October 20 the atmosphere thermometer having fallen 53 per cent., the sun thermometer has fallen 46.2 per cent. The temperature belonging to the well-spring[1] occurs on May 23, and October 4.

The Dew-point Temperature declines rapidly during this Section,
.10 —the rate of the decrement being 0°.18 per diem; but this is,
.28 still, much less than the rate for atmospheric temperature: the max.

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[1] See Page 2.

Sect. X.
Oct. 7—Nov. 5.

Sun's Decl.
5°.4 S.—15°.6 S.

43.1

change for any one day is 0°.28, and this maximum falls, also, on October 12. In the Spring Section of mean temperature (Sect. IV.) the rate of change is greatest in the dew-point temperature. The dew-point attains the annual mean value on October 31,—eleven days later than the atmospheric temperature does: in the Spring, the annual mean dew-point falls on May 12,—seven days after atmospheric mean temperature. The difference between the two temperatures for this Section is less than the annual mean value, and it undergoes daily diminution from the beginning of September to the end of November.

29.970

$-.056^{a}$

The Atmospheric Pressure has a low value for this Section,—.056 in. below the annual mean: Section III. has the lowest value, and this the next lowest: of the months, October has the lowest value, and April the next. This pressure having, as already stated, attained its min. value on October 4, then increases daily—with a very trifling exception of five days—unto the end of the Section. This history of this Section will serve further to illustrate the way in which the pressure and the movement of the atmosphere are dependent upon its hygrometric condition and action.

$-.073^{a}$

$+\frac{1}{168}^{b}$

$+\frac{1}{123}^{b}$

The Air Pressure is .039 in. greater for this than for the preceding Section, but it is .073 below the annual mean; this pressure augments during the Section as well as the atmospheric pressure, and the augmentation is greater in this than in the atmospheric pressure; the increment in these two particulars being, respectively, .239 or $\frac{1}{123}$, and .177 or $\frac{1}{168}$,—the defect in the pressure of air having far exceeded that in the pressure of the atmosphere on October 4; and it is, still, more in defect than that of the atmosphere.

$+.016^{a}$

$-\frac{1}{5.3}^{b}$

The Vapour Pressure is .057 in. less for this than it is for the preceding Section; it is still .016 in excess of the annual mean: it loses during the Section, and the decrement amounts to .062 or $\frac{1}{5.3}$, and on November 1 the pressure falls below the annual mean. The vapour pressure and the air pressure do not now, as in the preceding Section, show a tendency to augment or diminish together; they now act vicariously, and this vicarious action is in accordance with a general law, as will be shewn hereafter;—the law being, that the two pressures act vicariously, as regards the constant tendency and the permanent condition of the atmosphere: they commence a vicarious action on October 5, and continue it to November 9. The force of wind falls below the mean on October 5, and is 0.19 in defect for the Section.

2.23

SECT. X.
Oct. 7—Nov. 5.

Sun's Decl.
5°.4 S.—15°.6 S.

Increment of atmospheric vapour is gradual, and manifests but
little influence in producing currents, or sudden changes in the
barometer; the atmosphere maintains its equilibrium under the slow
action, by virtue of the vicarious movements: but when the vapour
is precipitated as a liquid or solid the change is comparatively
sudden, and the resulting void in the atmosphere gives rise to rapid
currents and great depressions of the mercury before the vicarious
action can restore the equilibrium:* the variations of the barometer
are more connected with precipitation than with the proportion of
vapour: and the barometer affords an indication of what is going on
in the atmosphere at a distance, rather than at the site of observation.
The variations in the quantity of vapour in the atmosphere are small
compared with the variations in the barometer: the mean vapour
pressure constitutes only $\frac{1}{108}$ part of the mean atmospheric pressure.
The highest value that has occurred for atmospheric pressure at
9 a.m., during the sixteen years, is 30.912 in.; and the lowest is
28.491;—occurring respectively in February and January, and
2.421[a] giving a range 2.421: the corresponding highest and lowest values
for the dew-point—occurring respectively in August and February,
are 69°.0 and 9°.0,—equivalent to the vapour pressures .708 in. and
.643[b] .065, and giving the range .643: the *range* of vapour pressure thus
constitutes nearly $\frac{1}{4}$ part of the range of atmospheric pressure.† The

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* February 20—25 has a force of wind above the mean, and on these days decrement of vapour obtains without vicarious increment of air.

† The difference between the average annual maximum and minimum for atmospheric pressure is .322 in.: the fall of rain during the period of precipitation, *i.e.* October (see page 81), is 5.063 in.; this would balance .372 in. of mercury, and would be adequate to put the atmosphere in motion, as well as to affect the height of the mercurial column. The vapour pressure is .066 less on October 31 than on September 30: the *supply*, therefore, in the month, is .306; and whilst the vapour condensed amounts to .012 per diem, the supply is .010. If the site of observation have a central position as regards the deposition, the site, then, becomes the point to which the resulting current tends, and where it necessarily comes to rest; and the supply of vapour will in this case, probably, nearly equal the loss,—it may possibly quite equal it; and the vapour which is thus transferred from one locality to another will inevitably drag the air along with it; but the influx of air thus brought about will not attain its greatest activity until the condensation has begun to subside. If we suppose the centre of deposition to be northward of the site, whilst the source of the vapour is southward, there will then be a strong atmospheric current experienced; and if the deposition be long sustained, profuse, and extensive, it may very well cause very evident depression of the barometer.

maximum of atmospheric pressure is .938 above the annual mean, and the minimum is 1.483 below mean: the maximum of vapour pressure is .431 above the mean, and the minimum .212 below: extreme depressions of the mercury and extreme accumulations of vapour have but little duration. It is commonly said, that the barometer falls with increase of vapour, because vapour is less dense than air: if a given bulk of vapour were substituted for the same bulk of air, this might be correct, but there is not such substitution in the natural actions: if any addition were made to the vapour in the whole body of atmosphere, certainly the pressure of the whole body of atmosphere would be so much the more; and if an addition of vapour were made to a limited column of atmosphere, the pressure of that column would be increased in proportion to the addition: the additional vapour, however, does tend to displace a certain quantity of air,—but not more than suffices to balance its own weight. If an addition were made to the air, or to the vapour, at any particular spot, the added quantity would seek to diffuse itself equably over the whole surface of the earth, and to thus increase the compound pressure; but if the whole body of air and whole body of vapour were put into equilibrium, the temperature would be such in some places as would reduce part of the vapour to water, and the equilibrium would thus be destroyed: the vapour constituent can never be in a state of equilibrium, because its tendency to become so by virtue of the law of gravity is always counteracted by the law of temperature.

$\left.\begin{matrix}+ & .938\\ - & 1.483\end{matrix}\right\}$

$\left.\begin{matrix}+ & .431\\ - & .212\end{matrix}\right\}$

On February 11, 1849,—the day of the extreme maximum of atmospheric pressure—the wind was N.N.E. and calm; the mercurial column had risen .398 in. at 9 a.m. since the previous day at the same hour, and it continued to rise for 1½ hour subsequently,—gaining in the interval .050: the vapour pressure at 9 a.m. was .212—which is only .083 below the annual mean for this hour, and .009 above the average value for this date: the humidity was at saturation point. The wind had been variable and calm from the 1st of the month, and it continued so for several days after the 11th. On Jan. 13, 1843,—the day of the extreme minimum of atmospheric pressure—the wind was W.S.W., with a severe gale and heavy rain: the mercurial column had been .050 lower in the preceding night at 12 o'clock: the vapour pressure at 9 a.m. was .229—which is .066 below the annual mean for this hour, and .079 below the average value for this date: the humidity was far removed from saturation

Sect. X.
Oct. 7—Nov. 5.

Sun's Decl.
5°.4 S.—15°.6 S.

point: the wind had been in the N.W. quarter from the 1st of the month, blowing strongly, with frequent hail, rain and snow: it was very variable after the 13th. On Aug. 7, 1846, the day of the extreme max. vapour pressure, the atmospheric pressure was 29.805, and the air pressure 29.097—about .510 below the average value for this month: the mean temperature for the day was 70°,—9° above the average value for the date, but by no means extraordinarily high: the weather had been cloudy and wet from the 1st day of the month; there was thunder on the 1st, thunder and lightning on the 3rd, a heavy storm of thunder, lightning, and rain, on the 5th, and a thunder storm on the 6th:—the lightning was probably occasioned by the sudden condensation of the inordinate quantity of vapour in the atmosphere. When the highly vaporised atmosphere reached the site of observation, much of the vapour must have been previously lost by condensation, and the atmospheric pressure diminished, but neither the defect in atmospheric pressure nor the excess in vapour pressure were so intense in the centre or focus of the storm as they were after this had passed: the great defect in the air pressure perhaps affords an indication of the great quantity of vapour there had been, *prior* to the storm. On Feb. 17, 1855, the day of the extreme min. vapour pressure, the atmospheric pressure was (at 9 a.m.) 29.917, and the air pressure 29.852—about .058 above the average value for this month: the mean temperature for the day was 22°.6, which is 16°.5 below the average for the date: the prevailing wind had been from the N.E. quarter previously, and there had been occasional sleet and snow—and, probably, an abundant fall of snow in the N.E., the atmospheric pressure being .073 below the average for the month.

The Humidity increases steadily during the Section: the whole increment amounts to the value 3.0.

The Fall of Rain is greater in this than in any other Section, but it is more profuse in October than in any other of the twenty-four divisions: the daily quantity is .012 in. more than in the preceding Section, and .056 above the annual mean. The fall of rain on October 4 is greater than on any other day, and from this date the daily quantities diminish unto October 15; but still, looking to the Sections, this is the one of greatest condensation, and, likewise, of the greatest decrement of temperature. It would appear that the

oyo

SECT. X.
Oct. 7—Nov. 5.

Sun's Decl.
5°.4 S.—15°.6 S.

site of observation becomes the centre of the periodical downfall early in October, when the fall is at its maximum,—the decrement of temperature attaining its max. value on October 12: it is true that the fall does not continue to increase quite to the 12th, but this is probably compensated for by the fall in the immediate neighbourhood; it soon, however, increases again at the site, and is as much as .171 on October 25: it is probable that at this last date the site of observation ceases to be the centre of condensation, for not only do the daily values diminish, but the S.W. winds, which had maintained a very high value previously, now subside, and the S.E. winds acquire a value above the annual mean from October 26 to November 10, and reach their highest value for the year on November 3.

The Rainy Days for the Section are more frequent than in the preceding Section: they attain a casual min. value on the last day, which is a trifle below the annual mean.

The Cloudy Days are more frequent than in the preceding Section: a casual minimum is attained on Oct. 20, which is 0.6 above the annual mean.

The Daily Change of atmospheric pressure is .021 in. above the annual mean, and .032 above the value for the preceding Section: .159
the highest values occur when the S.W. winds are losing, and the S.E. gaining, in prevalence,—the value for October 23 being .195.

Shortly before the commencement of Section IX.—on September 3—the atmosphere subsides into a state of repose: as the natural consequence of extreme points being attained, the usual meteorological action and changes are, for a time, suspended. In the course of the Section these extreme conditions cease,—as the sun's controlling influence subsides. During Section X. those changes which set in in the preceding Section gain force, become violent, and towards the close of the Section are extinguished through the meteorological revolution they have effected. Section XI. then commences with the elements restored to a state of comparative equilibrium and quietude, a period of unusual torpidity and stagnation ensues,—many of the previous active changes being reduced to a low rate at the end of this (the 10th) Section, or near that date: On October 30 the daily decrement of atmospheric temperature is reduced to a casual minimum of 0°.14: on October .12
29 the daily decrement of the dew-point temperature is reduced to

.10 a casual minimum of 0°.11: on November 8 the fall of rain is reduced
.090 to the casual minimum .083 in.: on November 9 the atmospheric
and air pressures attain casual max. values and become stationary—
29.970 the former being .050 in. above the annual mean, and the latter
29.693 .067: on November 9 the rainy days are reduced in frequency to a
8.6 casual min. value which is only 0.4 below the annual mean: on
16 November 4 the daily change of atmospheric pressure is reduced
.159 to the casual minimum .165: on October 27 the force of the
2.23 wind falls below the annual mean, and on November 16 attains the
1.30 min. value of the year; which implies that the state of equilibrium
has become general. Condensation is now quietly established as preponderating over evaporation—the contrary having been noticed at the opposite side of the meteorological circle: these two opposite conditions, which it must be supposed characterise the two hemispheres alternately and conversely, involve, most probably, opposite electric conditions, and a period of electric neutrality would appear to obtain from about the 1st to the 15th November.* Considering how little the fall of rain is regulated by the degree of humidity that is detected in the atmosphere, we seem to be driven to recognise electricity as an agent in producing rain:† at the Spring side of the year (that is to say, whilst the temperature is constantly augmenting) rain very frequently falls when the atmosphere is far removed from an extreme state of humidity; and on the other hand, it frequently happens that the atmosphere is *supersaturated* with vapour—moisture being visibly and continuously deposited upon almost every object exposed to it—in the midst of most determined fine weather, and with a high reading of the barometer: in the Fall of the year the humidity of the atmosphere is in accordance with the deposition that

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* This point will be further considered in Section XI.—See foot-note page 31.

† It must be admitted, however, that our means for estimating the hygrometric condition of the atmosphere are not quite satisfactory. The hygrometer is supposed to afford an indication of the pressure imposed by the whole column of vapour above the instrument; and the pressure must, of course, diminish with every increase of elevation, inasmuch as that a part must always be less than the whole. But in the experimental balloon ascents that took place in 1852 it was found, that both the thermometer and the hygrometer gave irregularly varying indications during the ascent,—and more especially the hygrometer; the dew-point being, occasionally, at a

occurs; and now the decrement of temperature is quite an adequate cause for the effect; and, further, the condensation produces electric disturbance;—setting free, apparently, a quantity of electricity proportioned to the vapour condensed; electric explosions are the result, and the electric fluid seems to pass from the atmosphere to the earth;—in the Spring it probably passes from the earth to the atmosphere;—and in the heat of summer it passes from one collection of cloud to another.

October 20 being the date of mean temperature, a number of particulars will now be collected corresponding with those already given for May 5. On the 20th October the sun's declination is $10^{\circ}.3$ S.: the atmospheric temperature is $49^{\circ}.4$:—the daily decrement is $0^{\circ}.24^{a}$: the dew-point temperature is $44^{\circ}.4^{b}$:—the daily decrement, $0^{\circ}.17^{c}$:—the difference between the two temperatures $4^{\circ}.9^{d}$: the atmospheric pressure is 29.912^{e} in., and is in the midst of a long course of increasing values; though just at this middle point an exception of five days duration occurs, which is of trifling amount, and, like that in July is obliterated by an additional pair of decadal reductions: the air pressure is 29.619^{f} in., and increases correspondingly with the atmospheric pressure: the vapour pressure is $.293^{g}$ in., and declining: the weight of vapour in the cubic foot being 3.31^{h} gr.: the humidity is 82.5^{i} and increasing: the fall of rain is $.154^{j}$ and increasing: the rainy days are $\frac{9.1}{16}{}^{k}$ and increasing: the cloudy days are $\frac{9.2}{16}{}^{l}$ and at a casual minimum: the daily change of atmospheric pressure is $.192^{m}$ in., and increasing. The force of wind on May 5 is 2.51, and on Oct. 20 it is 2.26: the annual mean being 2.23, the latter value appears low considering

16.2 N. } 10.3 S. }
49.5 } 49.4 }
.17 } .24 } a
41.2 } 44.4 } b
.24 } .17 } c
8.3 } 4.9 } d
29.931 } 29.912 } e
29.687 } 29.619 } f
.259 } .293 } g
2.69 } 3.31 } h
73.4 } 82.5 } i
.080 } .154 } j
8.3 } 9.1 } k
7.7 } 9.2 } l
.138 } .192 } m
2.51 } 2.26 }

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considerably higher value at a higher level, than it had been at a lower. Thermometric and hygrometric observations were carried on for the space of one year, simultaneously with those in Newport, on a spot elevated 180 feet above the Newport station, and about half-a-mile horizontally distant from it: it was found that the dew-point was frequently considerably higher at the higher station;—a comparison of the mean values for the year giving a difference of 0°.4: the weight of vapour in the cubic foot was on the average 0.09 gr. in excess at the upper station: for the month August the excess was so much as 0.34 gr. These results were obtained from observations made at each station at 9 a.m., daily, with wet and dry bulb thermometers which had been corrected by the same standard.

Sect. X.
Oct. 7—Nov. 5.

Sun's Decl.
5°.4 S.—15°.6 S.

that the equinoctial gales commonly prevail at this time of the year; but these gales being dependent upon sudden condensation of vapour and down-falls of rain, they are probably very limited as to their extent and as to their duration, and the mean value is consequently not much affected: a casual max. value is attained directly after the date of the equinox,—*viz.*, on Sept. 26, but this only reaches 2.47, —the annual maximum being 2.78: the value for Oct. 22 is a casual max. value also,—the force subsiding progressively after this date unto the middle of November: at the vernal equinox there are six days of decreasing values, but with this exception they increase from March 5 until April 4,—having the value 2.30 on March 21.

SECTION XI.

Sect. XI.
Nov. 6—Dec. 15.

Sun's Decl.
16° S.—23°.3 S.

Section XI. includes 40 days;—the first and last of which are November 6, and December 15. The characteristic of this Section is a very humid state of the atmosphere, instead of copious downfalls of rain which gave a marked character to the preceding Section. Fog, mist, clouds and frequent rain are now the customary phenomena. The temperature of the surface of the earth is now brought more to an equality with that of the higher atmosphere, through the medium of copious rain: and the whole mass of atmosphere is, consequently, in a more equable condition.

The Sun's Declination on the terminal days is, respectively, 16° S., and 23°.3 S. The expanse of sea that now becomes subject to his vertical rays is very great, and the area of land small: the quantity of vapour supplied to the atmosphere must be very great, but the sun's influence will now tend much more to send vapour towards the south pole, than towards the north pole: the diminution in the supply to the North will occasion a subsidence in the atmospheric currents; and, accordingly, the force of the wind has a lower value for this Section than for any other of the twenty-four
2.23 divisions;—the value being 0.49 below the annual mean.

The Atmospheric Temperature declines from 46°.4 on the first
.12 day, to 41°.7 on the last day,—a decrement equivalent to 0°.12 per diem; the decrement is so much as 0°.24 for each day, from

SECT. XI.
Nov. 6—Dec. 15.

Sun's Decl.
16° S.—23°.3 S.

November 9 to the 12th, and it is remarkable that notwithstanding this rapid decrement, the air feels oppressively warm at this time, and is supposed to rise in temperature;—just the converse of what occurs at the latter end of April: after the 12th it proceeds at a diminishing rate, and on December 5 a minute retrograde movement commences, of four days' duration; but this retrogradation in the daily values is obliterated by an extra decadal reduction.

November 11 is Martinmas day, and this festival has afforded a name for the first days of November as a recognised season possessed of special characteristics. The name given to this season is Martinmas Summer: Shakspeare alludes to the halcyon days of this Summer;* and those who take an interest in Guy Fauxes and Lord Mayors may be able to call to mind the sensible character of the season;—the characteristics may be summed up in the one word *muggy*. The season stands in remarkable contrast to the black-thorn winter of Spring, as will be more fully shown further on. Neither of these seasons owes its popular name to the atmospheric temperature that actually accompanies it: the 21st of April and the 9th of November are the days on which the peculiarities of the respective seasons attain their maximum intensity:—on April 21 the temperature is only 1°.9 below the annual mean value, and the rate of *increment* is 0°.13 per diem; on November 9 the temperature is 3°.7 below the annual mean, and the rate of *decrement* is 0°.24 per diem: the difference between the atmospheric and dew-point temperatures on April 21 is 8°.61, the annual maximum being 8°.67; on November 9 the difference is 4°.3, the annual minimum being 3°.6: the humidity on April 21 is the annual minimum, *viz.*, 71.7; on November 9 it is 82.6, the annual maximum being 87.6: the force of the wind on April 21 is 2.12, the annual maximum being 2.78; on November 9 the force is 1.51, the annual minimum being 1.30. Shakspeare's expression "halcyon days" is quite true to nature, as might be expected. The two seasons do appear to

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* *Puc.*—"Assigned am I to be the English scourge,
This night the siege assuredly I'll raise:
Expect Saint Martin's summer, halcyon days,
Since I have entered into these wars."
HENRY VI.—*Part* 1.

SECT. XI.
Nov. 6—Dec. 15.

Sun's Decl.
16° S.—23°.3 S.

constitute two most important œras in the year as will be presently shown.

The Dew-point Temperature declines in conformity with the
atmospheric temperature, but keeps more to one even rate: the
10 mean rate is 0°.11. The difference between the two temperatures
is very small in this Section,—the month December being the only
one of the twenty-four divisions that gives a lower value: the day
3.5 that gives the lowest value in the year is December 3,—the value
being 3°.5.

The Atmospheric Pressure is .024 in. below the annual mean: it is in excess of the values for the two preceding Sections, and in defect as compared with the three succeeding. During the period November 27—December 5 the pressure increases by .109; and on December 9 it is .015 above annual mean. On April 21 this pressure is .003 above the mean, and on November 9 it is .049 above.

The Air Pressure is great in this Section: .013 in. above the annual mean. During the period Nov. 27—Dec. 5 this pressure increases by .101. On April 21 this pressure is .0423 above the mean, and on November 9 it is .0655 above.

The Vapour Pressure is low, but the four succeeding Sections have lower values; the value is .037 in. below the annual mean: the last day has a value .0404 below that for the first,—giving a rate .001 per diem; but during the four days Nov. 9—12 the rate is .022, and during the last three days of November and first five of December the values are nearly stationary: the suspension of the decrement of vapour pressure during these days may account for the retrograde atmospheric temperature at about the same period; but the suspension alluded to is liable to misconstruction: the decrement in the *proportion* of vapour in the atmosphere is very little checked, but the height of the atmosphere is increased—an accumulation of atmosphere takes place, and it is in consequence of this that so little reduction in the vapour pressure occurs: the accumulation of atmosphere is occasioned by a current from the North meeting that from the South,—the N.W. wind prevailing during the period Nov. 24—Dec. 6: the small diminution in the proportion of vapour affords additional evidence that the S.W. wind continues to prevail within a short distance of the site. The substitution of the N.W. for the S.W. wind implies that the site of deposition has been transferred to

SECT. XI.
Nov. 6—Dec. 15.

Sun's Decl.
16° S.—23°.3 S.

the N.W.;—the current to the cold northern regions from the South, returning in a S.E. direction to the English Channel. On April 21 this pressure is .0411 below the mean, and on November 9 it is .0163 below; making the great difference .0248 between the two,—the whole range for the year being .2197.

The Humidity has a high value; *viz.*, 6.6 above the annual mean,—the whole range for this particular being 15.9: the 12th Section alone has a higher value. The max. value for the year is 87.6 on December 3. April 21 gives the min. value for humidity, and on November 9—as has been already shewn—it is high, being 4 above the mean: this is the particular therefore which exhibits the most distinguishing characteristic in the physical condition of the atmosphere for these two dates.

87.6

The Fall of Rain is .021 in. in excess of the annual mean; and is less in this than in the two preceding Sections: the fall for November 23 is .152; on December 9 it is reduced to .091.

The Rainy Days are frequent,—0.7 in excess of the annual mean,—and just on a par with the preceding Section. 8.6

The Cloudy Days are more frequent than in any other of the twenty-four divisions except January: the value is 2.0 in excess of the annual mean; and on December 3 the excess is 2.5. The condensation of vapour at this period of the year is great, as compared with the precipitation. The value for cloudy days on April 21 is 7.4, and on November 9 it is 10.9.

9.1

The Daily Change in atmospheric pressure is at a high value,—.029 in. above the annual mean: the two succeeding Sections are alone on a par with this: the values increase daily unto November 27, when the value is .046 above annual mean: the mean daily rate of *decrement* in the atmospheric pressure for the Section is .0009, but the pressure is very fluctuating.

.159

A general summing up of some of the facts and views already given in connection with the mutual relationship of temperature and moisture may here, perhaps, be advantageously introduced. As the month September approaches, the regions to the east of the English Channel become the site of the principal periodical autumnal deposition: the max. intensity of the deposition in these regions, or rather its max. preponderance there, occurs on September 3, —this date being marked by the max. atmospheric pressure, &c.

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16° S.—23°.3 S.

The site of the preponderating deposition gradually approaches the neighbourhood of the Channel, and is in its greatest force here on October 4,—this date being marked by the min. atmospheric pressure. On October 25 the site leaves this neighbourhood, and is transferred to the South,—the deposition at the site of observation abating at this time, and the wind shifting. On November 9 a state of equilibrium is established in the neighbourhood of the Channel, as regards the relative temperature of earth and atmosphere, as regards the relative moisture and temperature of the atmosphere, and as regards the relative electricity of the earth and atmosphere,—the stagnation and humidity of the atmosphere being at this date very marked;—condensation now characterises the season rather than deposition.* On November 15 the Temperate Zone is in the state

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* The thermometrical equator is considered to be situated somewhat to the South of the astronomical equator;—it is pronounced to be so by Humboldt. If we take 3° to be the interval between the two equators; then, the date referred to in the Autumn, *viz.*, Nov. 9, will be 39 days after the date of the sun's crossing this southern equator whilst progressing to the South; and the 39th day after his crossing the same line whilst progressing to the North will be April 21;—this being the day characterised by conditions the converse of those belonging to November 9. It is highly probable that these two dates are those on which the southern and northern hemispheres of the earth, in turn acquire the preponderating temperature. This change would probably be accompanied with a reversal of its electric and magnetic conditions: on April 21, the northern hemisphere acquiring the preponderating temperature under the rapidly increasing influence of the sun's rays, would at the same time attain its maximum of excess over the atmospheric temperature; and the electric tension would, consequently, be at its maximum in this hemisphere, and at its minimum in the southern hemisphere; but the *quantity* of electricity would not be great, though exceeding that of the southern hemisphere. On November 9, fog and cloud (comparatively good conductors of heat) prevailing, and screening the earth from the sun's rays, whilst the previous rain as a medium of communication between the two elements would have brought the earth and atmosphere to the same temperature—as well as to an electric equilibrium; the electricity, under these circumstances, would be at a minimum degree of tension; and the temperature of the earth now subsiding below the mean, the quantity of electricity would also come to be in defect, as compared with the opposite hemisphere. At the hottest period of the year, the quantity of electricity would be great; the tension would not be great, because *both* the elements would be at a high temperature; but at the time that the temperature of the earth is at its maximum the tension would be greater; and the inequality that existed would be such as arose from the high temperature of the earth: but upon the condensation of the vapour occurring, electric tension would arise, and this would be dissipated either by electric discharges, in the

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16° S.—23°.3 S.

of equilibrium,—this date being marked by the great equality in the different directions of the wind, no one quarter varying much from its annual mean, and by the force of the wind being reduced to its minimum for the year. The temperature in the Temperate Zone not being such now as to precipitate the vapour there, the vapour passes on to the North, and the magnetic pole, or the northernmost districts

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form of thunder-storms, or through a copious fall of rain. At the coldest period of the year, the quantity of electricity would be at its minimum, and the tension would also be weak: departure from the state of equilibrium would depend upon the low temperature of the earth.

The thermometer kept in the sunshine will afford assistance in determining the actual dates of these four periods,—the temperature of the atmosphere, four feet from the surface, being by no means a sufficient indication of the temperature of the surface of the earth itself. This thermometer will probably give a correct indication of the date of the max. and min. heating power of the sun, as regards the surface of the earth; and the date of the max. value (86°.8) determined in this way is September 4, —the date of the most settled fine weather, with the highest as well as very stationary mercurial column. The date of the min. value (48°.9) is January 11, six days after the preliminary min. atmospheric temperature: the influence of cold atmosphere after this may probably reduce the tension to a still lower point. The annual mean values (68°.5) for this thermometer's daily readings, occur on April 25 and October 21: it may be assumed that heat would accumulate in the earth to its mean value, at an earlier date than April 25,—seeing that the thermometer would be more under the control of the cold atmosphere of this season, than the surface of the earth would be: the mean value might occur somewhat earlier than April 21; and on this day we have already supposed the balance to be reversed: the temperature of the atmosphere itself, four feet from the surface, does not attain its mean value until May 5. It must be supposed that the thermometer would attain its mean reading during the autumnal rains at a considerably earlier period than the earth would attain its mean temperature: as the thermometer concerned attains its mean on October 21, whilst the atmosphere, at four feet, attains its mean on October 20 under a rapid decline of temperature,—November 9 seems to be somewhat too late a date to assume for the terrestial mean; this being the day on which the reversal of the balance has been supposed again to occur. If April 19 and November 1 were adopted as the mean dates, and a line were drawn across the annual circle, so as to cut the circle at points midway between these dates, the circle would then be divided into two equal parts,—the points of intersection being January 25 and July 26; and these days are respectively 35 days after the shortest day, and 35 days after the longest day; there would be 195 days above the mean values, and 168 below the means: it is curious, too, that these points of intersection are placed just midway between the dates of the two principal max. values, and of the two principal min. values for atmospheric temperature; and they are also placed respectively 12 days anterior to the pole of low atmospheric temperature, and 9 days anterior to the pole of high atmospheric temperature; (see p. 15).

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Sun's Decl.
16° S.—23°.3 S.

of America, probably becomes the principal site of deposition about the end of November, when the N.W. winds have their greatest preponderance.* The *commencement* of the period of northern deposition is marked by the simultaneous diminution of all the three pressures; the atmosphere losing .149 in the period Nov. 13—22, the air losing .139, and the vapour .0154: the return current soon restores the equilibrium, and even substitutes excess for deficiency.

SECTION XII.

Sect. XII.
Dec. 16—Jan. 24.

Sun's Decl.
23°.3 S.—19°.3 S.

Section XII. has very much the same characteristics as the preceding Section: it includes 40 days;—beginning with December 16, terminating with January 24.

The Sun's Declination on the first day is 23°.3 S., and on the last 19°.3 S.;—the extreme declination, 23°.5, being attained early in the Section. The area between these latitudes includes a large proportion of sea; and 10 degrees further South there exists an exclusively sea surface.

The Atmospheric Temperature declines during this Section, but not continuously: for a few days the daily rate of decrement is considerable, notwithstanding the period of the year and the sun's
.12 position,—being on December 20 so much as 0°.22: on January 6 the temperature begins to rise, having fallen from 41°.5 on the first day of the Section, to 39°.2 on January 5: after this date a daily increment continues unto the first day of the succeeding Section, the value for the day before being 40°.0: on January 11 the sun thermometer attains its min. reading. This rise in the temperature prior to the attainment of min. temperature is not an accidental, but a permanent, normal occurrence: it is not less marked when elicited from a larger, than when elicited from a smaller, number of years.

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* The magnetic pole probably has the lowest mean annual temperature in the northern hemisphere; but the extensive land districts of northern America are probably subject to a lower temperature than ever occurs within the arctic circle. Sir G. Back observed the thermometer at — 70°, in lat. 63, long. 109 (7 degrees south of the magnetic pole); and this is, perhaps, the lowest atmospheric temperature on record.

SECT. XII.
Dec. 16—Jan. 24.
Sun's Decl.
23°.3 S.—19°.3 S.

On December 6, a slight and transient increment of temperature is noticed: at this date the sun is about to desert the whole of the arctic regions, and it is therefore very probable that at this time deposition becomes very active there. On January 18,* when the rate of the then existing increase of temperature is at its maximum, the sun's rays have made a slight advance again into the arctic regions, and the temperature is, probably, at about its min. value there; whilst further South—in the Temperate Zone—there may be some increase in the production of vapour, and there would consequently then be a recurrence of active deposition, though much below what it had been; and, consequent upon this and the very low temperature, a current of vapour and air from the South; and accordingly, at this date the prevalence of S.W. winds is 2.0 above its average,—this prevalence having fallen far below its average between December 6 and January 18. This may account for the great *rate* of increment of temperature at the latter part of this Section, but the altered position of the sun would probably of itself be sufficient to occasion increment. But if the rate of this preliminary increment be great, that of the succeeding decrement—which brings us to the min. temperature of the year—is still more remarkable: this period of decrement (Jan. 26—February 11) comes within the limits of the first Section; but the decrement and increment are so closely connected as to their causation, the one being as it were a necessary sequence to the other—each depending upon the same meteorological principles,—that it is better to take both into consideration together. The explanation now to be given of the period of decrement will afford strong confirmation of the view already taken of the period of increment: the two processes may be said, to a great extent, to be one and the same result;—as the opposite movements of the two portions of a cord suspended upon, and traversing, a pulley, are. The two periods are nearly of the same duration, the increment occupying 20 days and the decrement 17: but the decrement includes somewhat the greater range of

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* On Jan. 21 the sun's rays again reach the latitude of the magnetic pole, *i.e.* the latitude of lowest temperature, and therefore this may be about the date of lowest temperature, at the spot of lowest temperature: it may be noticed that Back's very low temperature,—70°, occurred on Jan. 17.

SECT. XII.
Dec. 16—Jan. 24.

Sun's Decl.
23°.3 S.—19°.3 S.

temperature; and consequently whilst the mean rate of the increment is 0°.05 per diem, that of the decrement is 0°.08 per diem:* this excess in the process of decrement over that of increment is attributable to the very low temperature which obtains at this time in the arctic regions, which now supercedes the influence of deposition there. The increment of temperature—which is at its max. intensity on January 18 and 19—having been brought about by the prevailing influence of the atmosphere from the S.W.; so, the decrement of temperature is brought about by the return current from the North; the S.W. current is most influential at first, and whilst deposition is in prevailing force: the north, and more especially the N.E., current is most influential latterly, and whilst low temperature is the prevailing agent: the direction of the wind is N.W. during the greater part of the period of decrement; but is N.E. at the close of this period. Thus the second and principal min. temperature is occasioned, not so much by the position of the sun, as by the circumstance of the supply of air coming from regions of low temperature: at the one period our atmosphere probably flows from tropical latitudes,—at the other from the arctic regions.

When the site of principal deposition is transferred to the arctic regions, the meteorological actions seem to put on a new character: the revolving atmospheric currents which seemed previously, as a general rule, to exist between the lower and the higher latitudes of the Temperate Zone, now exist between the higher latitudes of the Temperate, and the Frigid Zone: the English Channel—in this neighbourhood—seems to be somewhere about the boundary of each atmospheric circuit; and, consequently, the north tending and south tending branches of the respective circuits, each, in turn, and at comparatively short intervals, gain the preponderance,—each occasionally pushing some distance beyond the ordinary limit. Under these circumstances great vacillation is observed in the hygrometric condition of the atmosphere, and in its pressure, as one or the other current gains the ascendancy; or, as they meet together, and each obstruct the progress of the other. The following account of how the atmosphere comports itself at this time, will be rendered more readily intelligible by arranging some of the particulars referred to in a tabulated form.—See page 75.

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* The rate of decrement during the period December 9—Jan. 4, already noticed, (this being the interval between the December increment and the January increment) is yet more remarkable; but being dependent upon a distinct, though closely connected, cause, it will be more appropriately discussed under the head of Dew-point.

Upon the site of deposition being transferred to the high latitudes on November 15, the atmospheric current is decidedly from the S.W.; but the return current from the N.W. soon after manifests itself. **B**etween November 15 and November 23 the S.W. wind preponderates: the vapour loses $\frac{1}{23}$ of its pressure, but the air loses only $\frac{1}{282}$; on the 15th, the proportion of vapour in the atmosphere is 1 in 120; and on the 23rd it is 1 in 125. **B**etween November 24 and Dec. 6 the N.W. wind preponderates, but the N. and S. currents nearly balance one another: the vapour pressure now loses only .004, and the air gains .131: the N. and S. currents meet, and the atmosphere accumulates instead of flowing onward: the impediment is such that at the termination of the period the vapour pressure ceases to decline, and the temperature rises: the vapour loses only $\frac{1}{55}$ of its pressure, (less than 2 per cent.) but its proportion to the atmosphere having been 1 in 126 on the 24th, is 1 in 129 on the 6th (nearly 3 per cent. difference). **O**n December 9 the wind is again blowing from the S.W., and it appears that it proceeds onwards without much obstruction; for the force of wind between Dec. 9 and Dec. 15 is above the mean: the vapour, consequently, loses $\frac{1}{39}$ of its pressure, and the air $\frac{1}{2543}$; and the temperature falls again, notwithstanding the change in the wind from N. to S.: the proportion of vapour to atmosphere sinks from 1 in 129 to 1 in 132. **B**etween December 18 and January 3, the N.W. wind preponderates, and the current has considerable velocity: the vapour loses $\frac{1}{16}$ of its pressure, though the air gains,—having commenced doing so with the change of wind: this great consumption of vapour and diminished pressure, together with the N. direction of the wind, is attended with a rapid decline of temperature,—this being reduced to the preliminary minimum: the proportion of vapour in the atmosphere changes from 1 in 135, to 1 in 145. **B**etween January 5 and January 25 the S.W. wind again preponderates, and during the period acquires a very high value, as does also at the same time the force of wind: this is attended with stationary vapour pressure, and

SECT. XII.
Dec. 16—Jan. 24.

Sun's Decl.
23°.3 S.—19°.3 S.

a very small increase of air pressure: it would appear from this that the S.W. wind meets an opposing current, but at a considerable distance from the site; and it would also appear that there must be diminished consumption of vapour or an increased supply,—probably there is both: the result is an increment of temperature; and this attains its greatest rate on January 18, just when the S.W. tendency is greatest and the force of wind is increasing, and, moreover, at the same time that the vapour pressure acquires an increased value: on the 5th Jan. the proportion of vapour is 1 in 145, and on the 25th it is 1 in 145; but on the 19th it is 1 in 144: the five first days of this period differ from the remainder of it, the vapour losing $\frac{1}{690}$ of its pressure, and the air losing $\frac{1}{684}$ of its pressure. It would appear that on January 5 the arctic deposition is still sufficiently active to exercise control over the different ingredients of the atmosphere at the site of observation; but it subsides, and in a few days it is only sufficient to balance the supply, and subsequently does not suffice even for this, the vapour pressure being .0014 greater on the 18th than on the 10th: after the 18th the arctic cold becomes the efficient agent, rather than the deposition; and the rise of temperature reaches its maximum on the 25th. Between January 28 and February 11, the N.E. wind constantly increases in influence; on Feb. 1 it is above its mean value, and on the 9th obtains the preponderance, instead of the N.W. or S.W.: during the period, the vapour loses $\frac{1}{19}$ of its pressure, whilst the air gains $\frac{1}{689}$: on the 28th Jan. the vapour is 1 in 146 of the atmosphere; on the 11th Feb. it is 1 in 155: the gain in the air pressure is accounted for by the opposition current,—the S.W. setting in again on the 13th. The period is marked by a rapid decrement of temperature terminating in the min. value for the year on the 11th. After this, dry cold N.E. and S.W. winds succeed each other, instead of the N.W. and S.W. There is an evident reason why the arctic wet season should be attended with a N.W. wind:—the site of the magnetic pole is to be regarded as having the lowest mean annual temperature, and the northern latitudes of America as exhibiting the lowest minimum that any part of the world is subject to; it is in these regions, therefore, that the greatest deposition is to be looked for, at the coldest period of the year, and beyond the range of the intertropical system; and then the wind would reach the site of observation from

SECT. XII.
Dec. 16—Jan. 24.

Sun's Decl.
23°.3 S.—19°.3 S.

the N.W.* The return current is probably directed to the Atlantic and the English Channel, and the counter-balancing current is,

minimum when the movement is reduced to 0, and then increases to the end of January; the mean difference for the Section is 0°.8 greater than for the preceding Section.

The most remarkable fact in reference to the dew-point, in this Section, is the very rapid decrement that occurs in its daily values

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* A line carried W.N.W. from Newport crosses Davis Strait and the north coast of America.

SECT. XII.
Dec. 16—Jan. 24.

Sun's Decl.
23°.3 S.—19°.3 S.

during the third and fourth weeks of December: if we take the fifteen days Dec. 14—28, the mean decrement for these is 0°.170, and the corresponding value for atmospheric temperature is 0°.166; .10 and the value for dew-point on each of the four days, 18—21, is .12 0°.22. The fall of rain at the site of observation is great at this time, but nevertheless the decrement in the dew-point is not attributable to this, which is proved by the circumstance that the decrement in the dew-point is proportionately by far the most prominent of the changes; this is the leading feature, and it must be this which leads to the decrement of temperature, and the latter in its turn, possibly, causes deposition: the loss of vapour here indicated in the atmosphere must be occasioned by deposition at a distance, and the arctic regions are the most probable locality: the period under discussion includes just that which may be considered to belong to the winter solstice, the sun's declination for the 14th being 23°.22, and that for the 28th 23°.31; the 21st being just midway between the other two dates, the value for which day is 23°.45. This position of the sun would tend directly to occasion a low temperature in the whole of the northern hemisphere; but the regions within the arctic circle are peculiarly circumstanced; not only is the land here absolutely deprived of the sun's rays, but so, also, is the atmosphere over a large part of the region, and for a considerable height above the surface of the earth. Under these circumstances it might be expected that some marked peculiarities would be observable in the movements of the atmosphere, as well as in the relative quantities of its different constituents at this time: accordingly, we find that the force of the current is strong, and especially that proceeding from the North and the West: the N.W. overpowers the S.W. on the 19th, and the force progressively increases from the 16th to the 26th, beginning with 2.25, and 2.23 increasing to 2.36; on the 21st, the vapour loses $\frac{1}{25}$ of its pressure subsequently to the 16th, whilst the air gains $\frac{1}{715}$ in the same interval; and the vapour constitutes 1 part in 139 of the atmosphere, instead of 1 in 133 on the 16th.*

The Atmospheric Pressure in this Section has the same mean value as that for the year, and is .026 in. in excess of the preceding Section.

The Air Pressure is .069 in. above the annual mean, and .056 above the value for the preceding Section.

SECT. XII.
Dec. 16—Jan. 24.

Sun's Decl.
23°.3 S.—19°.3 S.

The Vapour Pressure is .068 in. below the annual mean, and .031 below the value for the preceding Section.

The Humidity is 87.2, which is 8.6 above the annual mean, and above the value for any other Section, but the same as that for the month January.

The Fall of Rain has a value .012 in. above the annual mean, and below that for either of the three preceding Sections.

.090

The Rainy Days have a frequency equal to $\frac{9.6}{16}$: this is a higher value than is shown by any other Section; but that for January, and that for October a little exceeds it.

The Cloudy Days have a frequency equal to $\frac{11.0}{16}$; this is nearly the same as in the preceding Section, and exceeds the value for each of the other Sections. The most frequently cloudy day in the year is January 19,—already noted for the rapid increase of temperature then occurring—and this gives strong confirmation to the position, that the increment of temperature at this time depends upon accumulation of vapour: the value for Jan. 19 is 11.5. The sun thermometer, as has already been noticed, attains its min. reading for the year on January 11.

11.5

The Daily Change of atmospheric pressure has a higher value for this Section than for any other, and that for January exceeds the value for any other month: the value for the Section is .203 in.

PNEUMATICS AND HYDRAULICS

AS RELATING TO

METEOROLOGY.

MOVEMENTS OF THE ATMOSPHERIC FLUIDS.

The year's meteorological circle may have a four-fold division given to it, founded on the hygrometric condition of the atmosphere: and it may be said that the variations in the amount of vapour in the atmosphere are of no less importance as regards life, health, or science, than the variations in atmospheric temperature are; and, perhaps, the vapour regulates and distributes heat in no less degree than heat does the vapour. The first of these four divisions is the period of Aëration; the second, that of Evaporation; the third, that of Vaporisation; the fourth, that of Precipitation, or deposition. It will be found to be an arrangement more applicable to the circumstances, and in all respects as useful, if individual Sections, or Months (as the occasion may require) are selected as constituting or indicating the position, in the annual circle, of these seasons, as if a longer period—such as 91 days—were selected: the different periods cannot, advantageously, be arranged so as to succeed one another co-terminously, if the whole of the 365 days be included in the four categories.

The first Period, or that of Aëration, is that which gives the highest value for air-pressure; it includes the second Section (Feb. 24—March 22), which has a mean value for air-pressure of 29.826 in. March 8 gives the max. value for the year: and this value is 29.9258. The proportion of vapour in the atmosphere is 1 part in 147 for the period; and 1 in 151 for March 8. On March 8 the sun thermometer shows a rise of 31 per cent., though the mean daily atmospheric temperature has increased only 10 per cent. The precise point of the compass for the prevailing wind on the culminating day of this Period is N.E.

The Period of Evaporation is the fourth Section (April 19—May 18),—this being the season of the year when the humidity of the atmosphere being at a min. value, evaporation has its max. activity. The mean value for the humidity of this Section is 73.4. April 21 gives the min. value for the year: and the value for this day is 71.7. The proportion of vapour in the atmosphere is 1 in 116 for the Period, and 1 in 127 for April 21. The vapour pressure on these occasions is, respectively, .2587 and .2364,—the annual mean being .2775: the characteristic feature is, therefore, to be attributed to the *relatively* high temperature. On April 21 the sun thermometer shows a rise of 48 per cent.: whilst the increase in the mean daily atmospheric temperature is 39 per cent. The prevailing wind for April 21 is N.E. by N.

The Period of Vaporisation is the seventh Section, (July 21—Aug. 19)—*i.e.*, that which shows the largest amount of vapour in the atmosphere. The mean pressure of vapour for this Section is .410 in.: the weight of vapour in the cubic foot is 4.58 gr. August 3 gives the max. value for the year; the value for vapour pressure on this day is .4135 in.: and the weight of vapour is 4.59 gr. in the cubic foot: the air pressure on this day has the low value 29.534. The proportion of vapour in the atmosphere is 1 in 73.2 for the period, and 1 in 72.4 for August 3. On Aug. 3 the sun thermometer shows a rise of only 94 per cent. The prevailing wind for Aug. 3 is S.W. by W.

The Period of Precipitation is October,—this month being attended with the most abundant daily fall of rain. The mean daily fall is .163 in. October 3 gives the max. value for the year: the value for this day is .197; and October 4 is the most frequently rainy day in the year: the min. fall occurs on March 10. The proportion of vapour in the atmosphere for the period is 1 in 98, that for October 3, 1 in 88. On Oct. 3 the sun thermometer shows a fall of 37 per cent., whilst the decrement in the mean daily atmospheric temperature is 33 per cent. The characteristic feature is here to be attributed to the simultaneous high vapour pressure, and rapid decline of temperature. The prevailing wind for Oct. 3 is W. by S.

ELASTIC FORCE OF ATMOSPHERIC FLUIDS.

The atmosphere has always a tendency to find its own level, and, consequently, the more vapour the peculiarities of time and place may contribute to the atmosphere, the less air is there likely to be at that time and in that place;—the air not varying in its quantity, but shifting from one spot to another; so that the more there is in one locality, just so much less must there be in another: the whole quantity of vapour in the entire body of atmosphere is probably always the same, also, but it is known to be continually undergoing rapid loss and reproduction locally. The atmospheric pressure may be augmented either by an increase of air or by an increase of vapour: if an increase of vapour occur, in consequence of high temperature at the site of the increase, the condition is antagonistic to deposition;—the increment being combined with high temperature at the site, and deposition being precluded by the high temperature, the mercury of the barometer will rise: but if the increment be the result of high temperature in another locality, whilst it remains, or becomes, low at the site, deposition is likely to ensue; and if the deposition should commence on one—say the north—side of the site, whilst the vapour is supplied from the opposite—or south—side; then, the mercurial column will sink, the site will very probably afterwards be involved in the condensing action, and subsequently the influx of vapour may cause the column to rise again —deposition being arrested.

The different ingredients of the atmosphere are not to be regarded as being combined into one substance; but as being intermingled with one another;—each acting independently of the others: and thus the air and the vapour each act in obedience to laws peculiar to itself. It is very common to speak of the air as being saturated with vapour, or moisture; or as being so many degrees removed from saturation: the expression saturation thus applied is a convenient one, but it involves a meteorological absurdity; and it should be clearly understood what the atmospheric condition is which is referred to. The term implies what is not the fact; *viz.*, that saturation depends upon the relative quantities of air and vapour, and that if more air were added to a saturated mixture it would then be no longer in a state of saturation: but the condition called saturation does not depend upon the proportion of air, and does not apply to the *air* at all: it is a condition belonging exclusively to the vapour; but, it is an absurdity to represent the vapour as saturated with itself. If any quantity of atmosphere, in the so called state of saturation, were enclosed in a given space, and any quantity of dry air (supposing it not higher in temperature) were then added to the mixture; this would not in any degree counteract the state of saturation, it would act rather in the contrary way, in consequence of the additional pressure: but if any quantity of vapour were added, just so much vapour as was added would immediately (leaving out of consideration the small encroachment upon space that the newly formed water would occasion) be condensed into the form of water. When the air is said to be saturated, the fact alluded to is, that the vapour, as a separate and independent body, is subjected to such a high degree of pressure and such a low degree of temperature, that any increase in the pressure, or diminution of the temperature, would cause a part of the vapour to be condensed into water; and the pressure upon which this depends, is that which it sustains from *itself*,—depending exclusively upon its *own* amount. But though the pressure is its own, this is not the case with the temperature: any admixture of air with the vapour does not affect the vapour pressure; but the temperature of the superadded air will be imparted to the vapour, and bring it either nearer to, or further from, the point of saturation (*i.e.* the point beyond which it is incapable of sustaining itself in a state of vapour) according as the temperature imparted is lower or higher than its own: the temperature *belongs* neither to the air nor to the vapour, but may be transferred from one to the other.

Upon comparing the twelve Sections with one another, it is found to be the fact, that those which show an excess of vapour pressure as compared with the annual mean, show also a defect of air pressure, and vice versâ: this is the case

Means	+.0181	+.0450

Note.—The values used for these calculations were not reduced by the decadal meaning.

vapour is supplied from the opposite—or south—side: then, the mercurial column

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TABLE 1.	Vapour Pressure.	Air Pressure.
Section 1	.1971 in.	29.7797 in.
,, 2	.2023	29.8204
,, 3	.2258	29.6901
,, 4	.2575	29.6878
,, 5	.3291	29.6558
,, 6	.3898	29.6036
,, 7	.4112	29.5573
,, 8	.3780	29.7124
,, 9	.3530	29.5756
,, 10	.2929	29.6259
,, 11	.2406	29.7102
,, 12	.2095	29.7626
Means of above	.2906	29.6818

TABLE 2.	Vapour Press. above or below (+ or −) the Mean.	Air Pressure above or below (+ or −) the Mean.	Prepondera-ting Values.
Section 1	−.0935 in.	+.0979 in.	+.0044
,, 2	−.0883	+.1386	+.0503
,, 3	−.0648	+.0083	−.0565
,, 4	−.0331	+.0060	−.0271
,, 5	+.0385	−.0260	+.0125
,, 6	+.0992	−.0782	+.0210
,, 7	+.1206	−.1245	−.0039
,, 8	+.0874	+.0306	+.1180
,, 9	+.0624	−.1062	−.0438
,, 10	+.0023	−.0559	−.0536
,, 11	−.0500	+.0284	−.0216
,, 12	−.0811	+.0808	−.0003

TABLE 3.

		Preponderating Values.		Preponderating Values.	Means.
Mean Sections	3	−.0565	9	−.0438	−.032
	4	−.0271	10	−.0536	
	5	+.0125	11	−.0216	
Means		−.0237		−.0397	
Extreme Sects.	12	−.0003	6	+.0210	+.032
	1	+.0044	7	−.0039	
	2	+.0503	8	+.1180	
Means		+.0181		+.0450	

neither to the air nor to the vapour, but may be transferred from one to the other.

Upon comparing the twelve Sections with one another, it is found to be the fact, that those which show an excess of vapour pressure as compared with the annual mean, show also a defect of air pressure, and vice versâ; this is the case with one exception only;—the Section succeeding the one of highest temperature, *i.e.*, Section VIII., deviates from the rule: the vapour is in this Section .087 in., and the air .031 in., in excess: the quantity of vapour is great, and the supply is great; but the surface of the earth itself, at this time, attains its max. temperature and the result of this appears to be, an upward current and an accumulation of atmosphere; the site of observation being apparently, at this time, at one extremity (the *tropical* extremity as it were) of a commencing vertical atmospheric circuit.

The subject now to be considered will be much elucidated, and better understood by means of the following Tables, as they give both a comprehensive view and a condensed arrangement of the facts implicated.

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„ 7	.4112	29.5573
„ 8	.3780	29.7124
„ 9	.3530	29.5756
„ 10	.2929	29.6259
„ 11	.2406	29.7102
„ 12	.2095	29.7626
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Mean Sections	3 4 5	−.0565 −.0271 +.0125	9 10 11	−.0438 −.0536 −.0216	−.032
Means		−.0237		−.0397	
Extreme Sects.	12 1 2	−.0003 +.0044 +.0503	6 7 8	+.0210 −.0039 +.1180	+.032
Means		+.0181		+.0450	

Note.—The values used for these calculations were not reduced by the decadal meaning.

Table I. gives the mean vapour pressure, and the mean air pressure, for each Section, and the total mean for each of these particulars. Table 2 shows that the vapour pressure is in excess of *its* mean value in each of the six Sections V., VI., VII., VIII., IX., X. of high temperature, and in defect in each of the other six; and that the air pressure is in defect of *its* mean in the same six Sections of high temperature—with the exception of Section VIII., and in excess in each of the other six. The third column in Table 2 indicates which of the quantities—*i.e.*, whether the plus or the minus quantities—on the same line in the other two columns have the preponderance. If the values, as represented in this third column, be arranged in four groups of three Sections each;—*viz.*, two groups containing the values belonging to the Sections of mean temperature; and two containing the values belonging to the Sections of extreme temperatures, as is done in Table 3; it will then be apparent, that each of the two former groups exhibits a preponderance in the minus quantities: and each of the two latter a preponderance in the plus quantities: and if the grouping be further condensed, so as to exhibit one category of mean Sections, and one of extreme Sections, the resulting value for the former category is −.032, and that for the latter category +.032. Table 3 affords, simply, a direct indication of the variation of atmospheric pressure in the specified periods of high, low, and medium temperature. Both the annual and the diurnal variations in the atmospheric pressure accompany increment and decrement of temperature; but they do so in reversed senses apparently; for the high pressure for the day is observed to occur at about the hours of mean temperature, and the low pressures at the extremes of temperature: this is, perhaps, a deception arising, merely, from the imperfection of our instruments; for a water barometer is found to indicate the changes several hours in advance of the mercurial barometer; and even the aneroid barometer acts with a similar deviation from the mercurial. It was thought worth while to ascertain whether the Greenwich observations would give the same results as to the particulars exhibited by these Tables, as the Newport observations do: in making this comparison, it became necessary to use the monthly grouping instead of the Sectional, and this is sufficiently satisfactory for the purpose of a comparison between the two localities, though this arrangement cannot give such marked results in either case. The results, as belonging to the duplex grouping may be represented as below.

	Greenwich.	Newport.
Winter and Summer	+.0077	+.0144
Spring and Autumn	−.0097	−.0131

The months December, January, and February are those in which the two localities exhibit very different actions, and give rise to the discrepancy here apparent: December shows a defect of vapour at Greenwich, great as compared with that at Newport; and an excess of air as compared with Newport,—the defects differing by .008, the excesses by .025: January shews a defect of vapour at Greenwich far beyond that at Newport,—the difference being .020: February shows an excess of air at Newport .017 beyond that at Greenwich, but in March this excess is rather the greater at Greenwich, although March 8 gives at Newport the annual maximum;—this making it appear that increment of air is at this time progressing from South to North. Under the monthly grouping there is no exception to the general rule corresponding to that shewn by Section VIII.

The same sixteen years of observation were used for both sides of this comparison of Newport and Greenwich.

The facts here brought under view are of some interest, and the laws connected with them are deserving of investigation. The periodical high and low readings of the barometer must certainly be accompanied with corresponding, and with opposite, conditions in other regions of the earth: the alternate high and low readings must occur under the like circumstances in each hemisphere, and, consequently, there must be simultaneous excess, and simultaneous defect, in the two: but, at the same time, the excesses that obtain in one region must necessarily be accompanied with equivalent defects elsewhere, and vice versâ. The great changes observed in the Temperate Zone cannot be balanced in the Torrid Zone, for it is well known that the alternations in question do not in fact occur there: neither can it be in the Frigid Zones, because the area of these is too contracted for them to be capable of counterbalancing such excesses as occur at the site of observation: the Temperate Zones probably each comprise separate and vicarious zones of excess and defect,—the precise boundary perhaps a little exceeding the limits of these Zones in each hemisphere, and thus encroaching on the Torrid Zone. But although the zones of vicarious atmospheric pressure are thus located, a very different arrangement obtains as regards the distribution of the separate atmospheric constituents: in this point of view the two hemispheres constitute the regions of vicarious conditions,—excess in the North accompanying defect in the South, and vice versâ: the one constituent of the atmosphere accumulates towards the North Pole, whilst the other constituent accumulates towards the South Pole, and each to such a degree as to produce excess in the compound element; and this is at the expense of intermediate zones, where defect in the compound element must obtain. Either the two collateral zones, in each hemisphere, must differ greatly in the range of latitude they respectively embrace, or else the barometer must indicate a much greater excess in the one than it does defect in the other; the inequality must be sufficient to compensate for the great difference that exists as to the range in longitude. The zones of excess become so, as a result of the great alternations of temperature they are subjected to.

In the northern hemisphere, when the sun has high north declination, a great accumulation of vapour ensues in the northern zone of excess,—this accumulation being far more than equivalent to the atmospheric excess: the zone of excess is not itself the principal source of the vapour which occasions the excess: the zone of defect is the principal source: the great *augmentation* of temperature in the latitudes included in the zone of excess, as compared with that in the more southern latitudes, and the high temperature in the former,—as compared with the yet higher latitudes, —cause the zone to receive, and to retain, the vapour produced in the South. The same principles which cause great atmospheric pressure during the hot season, (*i.e.*, Sections VI., VII., and VIII.) in the northern zone of excess, will infallibly cause a similar excess in the corresponding parallels of the southern hemisphere, during the corresponding season there. The mean value for the vapour pressure for the days comprised in the season is 92 per cent. above the annual min. value towards the maximum: that is to say, it is 92 per cent. of its own range, above zero: that for air pressure is 30 per cent. above zero. The great accumulation of vapour is partially compensated for by the efflux of air which occurs in consequence of the constant tendency of the atmosphere to preserve its own level; but the secondary, compensating action is far more sluggish than the primary originating one. The annual alternations of temperature increase with the latitude in both hemispheres; but the rate of increase is peculiarly great in the north Temperate Zone, in consequence of the progressive increase of land area from South to North, at least as far as to the English Channel: in the southern hemisphere, on the contrary, the land area progressively diminishes towards the Pole: both the excess and defect of vapour that occurs periodically in the latitude of the English Channel, is, therefore, probably, greater than obtains elsewhere; but the defect in localities in the neighbourhood of the sea will not be so marked as in inland districts. And it may be observed, that the influence vapour is capable of exercising upon the amount of the atmospheric pressure, and consequently upon the atmospheric movements, is greater than seems generally to be supposed: the highest value for atmospheric pressure for any one day in the year is 30.143 in., and the lowest value is 29.821, giving the range .322; the corresponding range for vapour pressure is 0.22 in. (.2197),—showing the ordinary annual variation in vapour pressure to be equal to two-thirds of the variation in atmospheric pressure: if the comparison be made with the Sections which give the highest and the lowest values, the range of vapour pressure is then found to exceed that of atmospheric pressure,—the respective values being .211 and .1745.*

During the cold season (Sections XII., I., II.) also, a high reading of the barometer is observed in the zones of excess—the excess, although of an opposite character now, being the result of the same principles of action as before As the temperature declines progressively from the heat of summer, so, deposition ensues: a vacuity is thus produced in the atmosphere, and this vacuity has to be made good—the balance must be restored. Some estimate of the loss thus sustained may be formed from the following facts; *viz.*,—the atmospheric pressure subsides from its max. value for the year on September 3, to its min. value on October 4, at the site of observation;—this being a locality, too, where the vapour would be maintained at a high value long after deposition was progressing with great activity in neighbouring inland localities: at the site of observation the vapour loses during the month October, $\frac{1}{5}$ of the pressure it exercised on the last day of September; and the loss is equivalent to full $\frac{1}{5}$ of the annual range of atmospheric pressure: during the thirteen days, Oct. 5—17, the loss sustained is more than $\frac{1}{9}$. The inevitable deposition that occurs in the fall of the year occasions a great disturbance in the equilibrium of the atmosphere, which flows in—more especially from the southern latitudes—to correct the deficit: at the locality whence the atmosphere flows, the quantity of vapour being regulated by the temperature, all the vapour that is drawn away to the site of deposition is immediately made good by vaporisation, or else by suspended deposition; and on the other hand, all the vapour that is received at the site of deposition is immediately lost by deposition: but the air is not subject to such loss and reproduction; all that leaves one locality remains in some other; —*remains*, so long as it is required for the maintenance of atmospheric equilibrium at the spot where it is. As the season advances, the northern hemisphere comes to be the region of deposition, as compared with the other hemisphere, instead of one zone being so as compared with another in the same hemisphere, as had been the case earlier in the season; and, simultaneously, the southern hemisphere comes to be the region of vaporisation, as compared with the northern; and by the time minimum temperature occurs at the site, the air is strongly urged, on both sides, to flow from the southern zone of excess to the northern zone of excess; the former pushing it by its load of vapour to the North, the latter drawing it in the same direction by virtue of its loss of vapour weight. The air has a great range of latitude to travel over: it first passes from contracted latitudes to more extended ones; and between the tropics it is diffused over so wide a space as to make but little difference to the atmospheric pressure there: it then passes on to more contracted latitudes again, and the height of the wave, as it progresses, increases with the latitude; and when the crest of the wave reaches the latitude of the site it has attained great elevation: the air has a great distance to travel over, but it is not, like vapour, subject to having its progress arrested by its destruction at a given latitude;—being once put in motion, it continues to move by virtue of its own inertia, and reaches the zone of excess at a date subsequent to that of minimum temperature: but there is another reason for the late arrival of the wave;—the date of min. temperature and of min. vapour pressure will not occur at the Pole till long after its occurrence in the temperate zone; it probably does not occur at the Pole until after the sun has crossed the Line; and this helps to keep the wave in motion till a late date, and its crest does not reach the site until the vapour pressure has gained 2.6 per cent., and the date of the occurrence is March 8.

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* A rapid precipitation of vapour, within a limited distance of the observer, may give rise to an efflux of vapour, and decrement of atmospheric pressure: and, if there should be a large area of sufficiently warm water within a given distance, the supply of vapour and its consequent influx at the site of observation may suffice to more than make good the loss of *vapour*, although the influx of air and vapour together be insufficient to counterbalance the efflux of *atmosphere*; and there would then result the deceptive appearance of the decrement of atmospheric pressure being contingent on the increment of vapour: but if the existing conditions should favour a greater influx of vapour than the actual efflux of atmosphere, an opposite result will then be observable,—atmospheric pressure will augment.

The vapour, at the one *season* of excess, and the air, at the other *season* of excess, are respectively above their mean values by the amounts, .1175 and .0909 (computing the values by the whole number of days): on the day March 8, the excess of air pressure is far more than that of the vapour excess on August 2;—the respective excesses above the respective means being .233 in. and .136 in.: the air excess is equivalent to 72 per cent. of the whole range for atmospheric pressure; the vapour excess is equivalent to 42 per cent. The air wave, upon arriving at the site, does not rest there, but progresses northerly—or at all events passes on beyond the site; and, what is remarkable, it leaves a deeper trough in its rear than that which preceded it:—taking the compound element, 95 (in 100) represents its position on the diagram on March 8: ten days subsequent to the 8th it is 41; whilst ten days prior to the 8th it is 50: sixteen days subsequent to the 8th it is 25; whilst sixteen days prior to the 8th it is 53: a marked minimum of 21 occurs on April 6, or twenty-nine days subsequent to the 8th; whilst a marked minimum of 25 occurs on January 11, or fifty-six days prior to the 8th: now this affords strong evidence that there is a great atmospheric deficiency—a great demand upon the supply—*further on*, subsequently to the 8th March; and that the vapour deficiency becomes greater, *further on*, than it had been at any time at the site: the mere vis inertia of the wave might cause it to overshoot the point of greatest defect, but the subsequent deficiency resulting from this cause would not exceed the first: the trough that thus manifests itself in the rear of the wave also affords evidence in favor of the assumed defect in the more southern latitudes as a counterpoise to the known excess in the more northern latitudes.

The great demand made upon the air constituent at the two Poles during their respective cold seasons must, apparently, occasion a deficiency in the latitudes bordering on each of the tropics, and these regions, therefore, are subject to atmospheric deficiency twice in the year, although the vapour pressure undergoes little variation there.

The two periods of the year characterised by defective atmospheric pressure are periods in which those changes are in active progress which result in the extreme conditions which have just been discussed, and which may be regarded as periods of repose intervening between periods of opposed action. The primary and principal agent in effecting these changes is the atmospheric vapour, and the changes are effected through the alternate production and destruction of the vapour,—the alternation, that is to say, of vaporisation and deposition, which occur vicariously in the two hemispheres according as the sun's position occasions an augmenting or a diminishing temperature. The accumulation of air at any spot always tends, mechanically, to its own arrest; but the condensation of vapour does not put a stop to its condensation, and deposition thus continues so long as the temperature continues to decline: the spot or the latitude which exceeds others in the amount of deposition there, will be that to which the air will flow; but whilst the deposition is rapid, the movement of the air is slow, and consequently when the vapour has been reduced to its mean annual value in the fall of the year, the air constituent will still be in defect,—it will continue to manifest, in a modified degree, that defect which obtained during the preceding hot season: thus the autumn season of mean temperature becomes a season of defective atmospheric pressure: the vapour pressure attains its mean value on October 30: the air pressure attains a mean value on December 2—remaining then above the mean until March 23. This being the progress of affairs in the northern hemisphere, vapour is accumulating in the southern hemisphere; the air is, consequently, pushed from South to North, by the vis a tergo, and an excess obtains in the latitudes bordering on the northern tropic, —this influx from the South not reaching the more northern latitudes till considerably later in the year.

In the spring period of defective atmospheric pressure the air settles to its mean level, at the site of observation; and the same condition probably exists over the earth generally;—the last important movement in favor of this level having been from the northern to the southern latitudes, in the northern hemisphere. The vapour is later in gaining its mean value, and consequently there is defective atmospheric pressure: the delay in the increment of vapour will be accounted for by the flow of atmosphere to the South, which must obstruct the flow of vapour in the opposite direction; but the increment of temperature in the southern latitudes of the temperate zone will have occasioned an accumulation of vapour in these latitudes, and, consequently, an excess in the atmospheric pressure: the air falls temporarily to its mean pressure on March 23; and then again more permanently on June 4: the vapour attains its mean value on May 12.

The deficiency of air in the Autumn far surpasses that of vapour in the Spring, and a very low reading of the barometer obtains in the former season: the great fluctuations of the air are from hemisphere to hemisphere, and require time for their accomplishment: but the vapour variations, not being regulated by, or dependent upon such far distant changes, are more speedily accomplished,—deficiencies are more readily made good. When the air supplied to fill up a vacancy does arrive, it is very liable to be in excess; but it is not so with the vapour.

The fluctuations of the air from Pole to Pole are very marked: the accumulation towards the Poles during their respective cold seasons is so great as to leave, not only the opposite Pole and the opposite hemisphere, but even—as is to be inferred—the latitudes bordering on the tropic in the same hemisphere in defect: the excess, in the cold season, towards the Poles, far surpasses the defect in the hot season: the excess (computing as before) at the site amounts to 0.0909 in.—the defect being .0749: the range over which the defect extends probably compensates for its comparatively small amount. The vapour does not *fluctuate* from Pole to Pole, but it augments and diminishes alternately and vicariously in the two hemispheres, and this action is most intense in high latitudes: the excess shown by this particular is, also, a far greater departure from the mean, than is the defect;—the amount for the excess being .1175, that for defect .0735.

The Torrid Zone is emphatically the region of permanency and invariability: as the sun's position is always somewhere within the limits of the zone, it is never removed for any long period of time from any of its latitudes:—as two summers and two winters recur every year, the changes are here necessarily small in the thermometric and hygrometric phenomena;—and it might consequently be predicated of the atmosphere, that it must maintain a very equable pressure through the year: at the Equator there is no well ascertained constant variation in this meteorological particular. Located as this zone is between the two great regions of periodical and reciprocal action and vicarious conditions, and having itself no zone of reciprocity, its meteorological character is in many particulars made up of the mean condition of the other two regions; and there is every probability that this mean is always of the same value: if the condition of the central region be not precisely the same as the mean of the two collateral regions, it is to be supposed there is constantly the same departure from it. The rapid revolution of this zone upon the earth's axis is productive of such great centrifugal force, which must be in some measure partaken of by the atmosphere resting upon it, that the atmospheric pressure is likely never to fall below the mean value. In the next place, any temporary increase of the atmospheric constituents, during their passage from one hemisphere to the other, would be diffused over so comparatively large an area, as would render it inappreciable. The north and south boundaries of this *meteorological* zone will vary, to some extent, periodically, with the sun's position in the ecliptic, but the equator will always remain the line of equality and mean value.

On either side of a narrow central band in this mid-way zone, is a zone which partakes of the immutability peculiar to the former, but, also, of the mutability pertaining to the zones still farther removed from the equator: these zones may be said to constitute the regions of the trade winds: it is here that the vertical revolving atmospheric currents are most constantly observed: neither the thermometric nor the hygrometric conditions of the atmosphere are subject to any great variations; but the zones are placed between a zone of heat on the one hand, and of cold on the other, and this permanent contrast of temperature gives a constant direction to the atmospheric current.

On the polar sides of the zones last referred to, there are zones characterised by mutability—by periodical and reciprocal change: great variations occur, as to the temperature, and the quantity of vapour, in these zones, in accordance with the season of the year: in the northern hemisphere, the difference of terrestial conditions in different localities gives rise to great differences as to the progress of the meteorological changes in the same parallels of latitude; and these same conditions also occasion great irregularity and uncertainty as regards the succession of changes in the same locality: but, nevertheless, by considering the facts in the gross—by reducing the daily occurrences to average values by various expedients, consistent and intelligible laws may be educed which are doubtless in harmony with the laws that obtain in localities where there is found to be greater regularity and constancy in the order of change.

The foregoing discussion serves the purpose of explaining the broad facts demonstrated in the Tables: there are other facts, at the same time co-ordinate and subordinate to these, the history of which gives support to the doctrines which have been advanced. The wave of air which gives an absolute max. value to the air pressure, and a relative (or casual) max. to the atmospheric pressure, on March 8, flows onward to the North, and brings after it a minimum which is noticed at the site on April 7: on arriving at the extreme North a reflux necessarily ensues, and on April 18 a maximum recurs, which however is but little above the mean value. On March 8 the air constituent forms 99.3 per cent. of the atmosphere: on April 7 it is 99.2 per cent., notwithstanding the temperature has risen greatly during the interval: on April 21 the atmosphere attains its min. value for humidity, and on this date the air is still 99.2 per cent., although the temperature is then only 2° short of the annual mean: these peculiarities afford strong evidence that the atmosphere flowed, first to, and then from a region where the temperature was comparatively low and the quantity of vapour very small. From the 26th March unto April 9 the S.W. is the prevailing quadrant, and the W. the prevailing semicircle for the wind: from the 10th April unto May 7 the N.E. is the prevailing quadrant, and the N. the prevailing semicircle—the E. being about on a par with the N., however, from April 21 to May 1: the S.W. attains its highest value (for the occasion) on April 1—4, the N.E. on April 17—20: the highest value for the W. is on April 4 and that for N. on April 15. The atmospheric flow would appear to be exclusively (*i.e.*, without any return current) from South to North whilst the trough of the wave is passing on April 7, and exclusively from North to South whilst the refluent crest is passing on April 18: from February 26 unto March 24 the N.E. and the N. winds prevail, and there is probably during this period a vertical circulating current with an upper stream from the South: from May 10 unto August 31 the S.W. and the W. winds have, generally, great preponderance; but at the commencement of the period, *viz.*, unto June 3, the S. interchanges with the W.; and on September 1, whilst the W. is exchanged for the N., the S.W. is exchanged for the N.E.: during May 10—Aug. 31 there is probably a horizontal atmospheric circuit maintained; that is to say, there are not two currents at the site at different elevations, but the whole body of atmosphere coming from the South flows on to the East, and returns southward in a more eastern longitude: when the summer current (*i.e.*, the S.W.) first reaches the site—where the summit of the curve of the current is then located—there is a strong eastward tendency; but as the northern winter current retires, the southern summer current advances, and, as it does so, acquires a more northward direction, this eastward tendency not being observable after June 3. The foregoing history of the atmospheric movements in March and April shows very distinctly the oscillating tendency of the air movements, which is very different from that of vapour: the vapour augments progressively from its mininum to its maximum; and then diminishes constantly to its minimum.

There is great oscillation observable in the air movements in the summer season of atmospheric excess, and, also, subsequently to this period: these oscillations cannot depend upon the quantity of vapour existing in the atmosphere where they are observed, because the variations in the quantity—even the decrements—take place gradually and progressively in such a situation as the Isle of Wight,—if not in inland districts—and it is the quantity of air that determines the height of the mercurial column, as is clearly illustrated by the Diagrams: neither can they depend, altogether, upon the deposition that occurs at the site of observation, because the first of these sudden movements—one of increment—occurs during a period of little deposition. During the thirteen days Aug. 21—Sept. 3, there occurs an increment of air pressure of 38.5 per cent. of its whole range; this increment must depend upon sudden deposition in some other locality: reaction then ensues, the air pressure falls from 64.5 per cent. above zero, to zero, on October 3—a decrement which, no doubt, is in a great measure dependent upon deposition at the site and its near neighbourhood; but so great a change must be attributable, in part, to the reaction connected with the vis inertia: the deposition attains a max. value at the site on October 3; and then declines rapidly: another oscillation upon this commences in the air pressure which, on November 9, is 62 per cent. above zero. These great oscillations must have quite a different origin from that which has been assigned to the oscillations at the opposite season of the year;—they are not now dependent upon the great wave proceeding from another hemisphere: the air pressure attains a very low value—10 per cent. above zero—on August 6, which is attributable to the max. excess of vapour then present, and may be regarded as the then normal balance belonging to the static condition of the atmospheric constituents: the subsequent oscillations are the effect of the movement imparted to the air by sudden deposition combined with the vis inertia. During the air accumulation of Aug. 21—Sept. 3 the influx would appear to be principally from the North-east, inasmuch as that the N.E. and the E. winds increase in their daily values during the period,—the N.E. increasing from August 21 unto September 5, and gaining the preponderance on September 1; the E. increasing from August 22 unto September 5: the S.E. also increases from August 25 unto September 12: during the whole of the period October 3—November 9 the S.W. and the W. have the preponderance, but the S.E. increases from October 11 unto November 3, and the E. increases from October 6 unto November 3,—attaining its max. value on November 3. The respective localities principally concerned in these changes would appear to be in different longitudes of nearly the same latitude.

DIRECTION OF WIND.

According to the theory commonly promulgated, there are two general laws by which the atmospheric currents are regulated: the difference of the temperature that obtains at the Equator from that which obtains at the Poles, is represented as producing currents from the Equator to the Poles at one level, and from the Poles to the Equator at another level: and in the next place, the motion of the earth upon its axis is represented as giving movement to the atmosphere in the direction of the Equator: the actual direction of the wind is represented as being that which results from these combined agencies. These two laws no doubt control, to a great extent, the movements of the atmosphere: but they do not suffice to account for all the movements which habitually and systematically occur, and they have, moreover, an application given to them which seems to be at variance with the laws themselves. A modified theory will, therefore, be offered, which recognises a third constantly acting agent.

We may imagine the earth to be in a state of rest, and the heat derived from the sun withdrawn:—under these circumstances the earth would be enveloped in stagnant air. Supposing the earth to be then put in motion so as to revolve constantly on its axis—moving from W. to E. say, the air would then immediately be put in motion also, and in the same direction: the air would gradually increase in rapidity of motion until it came to a definite approximation to that of the surface of the earth: the rapidity of movement, both in the earth and in the air, would be greatest, at the central line between the two poles of the axis: the relative defect in the air movement would be greatest at this same line,—the movement being 0 at the poles: at any given spot, and at every elevation, a lower stratum would have greater rapidity than a higher; and the rapidity would diminish rapidly with an increase of elevation: the motion diminishing towards the poles,—the diminution would be very gradual near the central line, but would become progressively more rapid in proportion to the proximity to the pole; through some 10° or 12° the decline of motion would be very small; but between 20° and 30° it would become very marked. If we suppose the northern hemisphere to have a more uneven surface than the southern, then the air would be most affected by the earth in the northern; or, if the surface were very level in the central region up to the parallel of 20° lat., and very uneven outside this line, the rapidity of the air's motion might then be even greater through a small range of the higher latitudes than in the central latitudes; and the latitudes of equal rapidity, in the two hemispheres, might be at very different distances from the central line;—the rapidity of the air movement at 30° N., for example, might be the same as that at 20° S.: the terrestrial and atmospheric movements would more nearly correspond at 20° N., than at 20° S.; that is to say, the easterly wind would be strongest at 20° N.; there is, in fact, a great difference in the two hemispheres of the earth as to the nature of its surface; for whilst the surface is very level in the southern hemisphere, it is very much otherwise in the northern: the difference commences at between 20° and 30° lat. with frequent alternations of sea and land; and between this line and the latitude of the English Channel there may be reckoned at least twelve separate mountain ranges attaining a height of 5000 feet, or more.

Suppose, now, the sun's heat to originate motion in the air, instead of the earth's revolving motion,—the sun's position being at right angles to the axis of the earth; and the sun must be supposed to be revolving round the central line of the earth's surface. The central line would now acquire great heat; whilst at the poles the temperature would remain comparatively low: the air at the line would acquire heat from the surface: the increase of heat in the air would cause expansion, and the expansion would be attended with a proportionate reduction of its specific gravity: this increment of temperature would obtain, principally, in the stratum in contact with the surface of the earth; and all of the heated particles would have a tendency to rise to a higher level: but the heating and expansion would be greatest at the line, and a column of atmosphere here would acquire a greater altitude than one at the pole;—the absolute weight, however, sustained by each successive portion of the earth's surface, from the line to the pole, would as yet be undisturbed. But, the *level* having been deranged, the air will put itself in motion to restore the level: the expanded air at the line will overflow that at its sides; and the consequence of this will be derangement in the equilibrium as to weight,—the dense column of air in the colder latitude having now to sustain the additional weight of the superimposed light air: the result of this will be that the heavy column will sink down, and flow along the surface to the light column, which it will underflow until the equilibrium is restored; and the air would then remain stationary, *provided* its temperature were not further altered; but, in fact, the air approaching the line is constantly subjected to a heating process; and that approaching the pole is constantly subjected to a cooling process; and the result of this is that a permanent revolving current is established. The flow of the air from the line *towards* the poles will be attended with a secondary effect;—the air flowing from a more extended to a more contracted area, it will accumulate and give further additional weight and additional impulse to the cold descending column: thus, the equilibrium would, in fact, be deranged long before the upper current reached the pole; and, *supposing* that a *portion* of the upper current flowed on to the pole, still it is probable that the conditions as to accumulation, weight, and temperature, of the atmosphere would be such, between the latitudes 20° and 30°,—where both the circumference and the temperature of the earth rapidly diminish—as to cause the downward and reversed flow of the atmosphere to occur there: it is probable that several zones of independent action are thus established between the Equator and the Pole. But according to the received theory, the current extends from one extreme to the other, and this involves the assumption, that the atmosphere flowing from the Equator *descends at the Tropics*, and then flows onward to the Poles at a low level; whilst an upper current flowing *to* the Equator descends at the same parallel, and, having disentangled itself from the opposition current, then flows on to the Equator: this combination, interlacing, jostling, and extrication of two bodies of air seems very unlikely to occur; and, if this did occur, it must necessarily produce great commotion and rapid currents in the air; whilst the zone where this phenomenon is supposed to occur is known to be one of remarkable calm: but in another point of view this perverse and contentious movement of the atmosphere seems to be impossible: the atmosphere proceeding from Pole to Equator is represented as assuming its actual low level position in the Torrid Zone, by virtue of its relatively low temperature: but if this be so, how could the current proceeding from Equator to Pole underflow *its* opponent?—they cannot be each colder than the other: if this poleward current descends in consequence of its low temperature, its course must then be directed to a warmer site instead of a colder, and it would return to whence it came: under the hypothesis here mooted the calm state of the atmosphere is sufficiently accounted for at the line of arrest.

We may now contemplate the practical combination of the two principles of action that have been described: the current which is directed towards the Equator by the law of temperature is also directed from E. to W. by the law of *relative* motion,—the motion of the earth exceeding that of the air: but, the air, retaining its absolute eastward movement derived from the earth, may be made to *surpass* the movement of the terrestrial surface immediately beneath it; because, the motion acquired by the air in a latitude of great circumference and rapid motion will be greater than that of the surface at a latitude of small circumference and slow motion: the current, therefore, that proceeds towards the pole will be likely to be felt by a stationary body on the surface of the earth as a west wind; whilst a current flowing in the opposite direction would be felt on the surface as an east wind, although it were actually moving *to* the East: the eastward impulse thus given to the air would become more marked as the pole was approached; because, the rapidity of the earth's motion would decline in geometrical proportion, whilst the space overpassed by the air increased in arithmetical proportion, and the pole-ward tendency might consequently be overpowered before the whole of the temperate zone were traversed. The received theory attributes the same movement to the upper strata of the atmosphere, eastward and westward, that it does to the lower; but this appears to be evidently an error: the terrestrial motion can but very little control the upper strata, and they would move in almost a direct line from the Equator to the Pole; and the earth being in motion from West to East, the current would have a relative westward course: but when the lower current has a relative westward course—as between the tropics—it would assuredly have more influence in keeping the upper strata with it, than the earth would have in the opposite direction, and concur in originating an E. wind: on the other hand, where the lower strata have an eastward and pole-ward direction—as in the temperate zones—the upper strata would accompany these; the two would form one W. current: but, even in this case, the *uppermost* layer would probably have a relative westward course; and having attained a given latitude, would descend and return to the tropic as an E. wind.

There is a third principle of action to be considered; we must recognise the fact that the heat of the sun draws vapour into combination with the air; and the compound atmosphere comports itself very differently from what the air would do alone: the vapour acts under laws of its own,—laws which the air taken alone is quite independent of; but the vapour, in its own proper action, controls that of the air, dragging it mechanically along with itself in a very marked degree. The peculiar characteristic attaching to the vapour is, that it is constantly disappearing from the atmosphere as one of its ingredients, and as constantly being reproduced: the production and the destruction are each effected near the surface of the earth, the production literally on the surface, the destruction (condensation) within the ordinary limits of a low level current, and often considerably below such limit: the production of vapour is partly dependent upon the nature of the surface yielding it: its loss depends upon the abundance of it in the atmosphere, and the local temperature, independently of the nature of the local surface: the vapour is always disposed to accumulate where the highest temperature is, and it consequently has a strong disposition to remain near the surface: vapour, like air and water, has a strong tendency to maintain its own level, and consequently flows from a region of excess to one of defect: one remarkable element of vapour action is, that it flows to a heated spot *if* the material for *making* vapour be defective there; as well as to a cold spot where there exist the means of destruction;—it seeks both accommodation and annihilation: when the current proceeds from a region of profuse supply to one of great heat, each principle of action—that derived from difference in quantity and that derived from temperature—is in its max. force at the lowest level. In the temperate zones the agent of destruction, *i.e.*, low temperature, is very generally met with by the vapour flowing to higher latitudes:

in the antarctic region the same law probably holds good; but in the northern regions the districts of lowest temperature are near the arctic circle.

A very different system of atmospheric currents obtains in the intertropical, and in the extratropical regions; and the difference is just such as might naturally result from the difference of hygrometric action. In the south temperate zone the atmosphere appears to be very much under the direction of the hygrometric law; it flows from the neighbourhood of the tropic at a low level—notwithstanding its high temperature—to the higher latitudes of low temperature; it assumes an eastward direction, as it proceeds southward, due to the impulse given to it by the earth: having parted with so much of its vapour as deprives it of its disposition to flow further to the South, it discontinues such movement; but deposition continues until so much vapour has been lost that the atmosphere becomes subject to the law of temperature; and it then flows back towards the tropic as a cold S.E. current, wherever the N.W. offers least resistance; this would occasionally be by the side of the N.W., but perhaps more frequently above it, at a moderate elevation: the preponderance of the hygrometric law over the thermometric law, about the parallel of the southern tropic, would oblige the return current generally to keep to the higher level until it found an opportunity of descending to the lower level at the tropical turning point. In the north temperate zone, also, the direction of the current would be very much influenced by the hygrometric conditions; and the *dry heated* land districts would frequently co-operate with the *cold latitudes* and cold mountain ranges: the current has probably a stronger eastward tendency than it has in the southern hemisphere, owing to the inequality of the terrestrial surface: having met with a locality cold enough to condense its vapour, the atmosphere would probably find many channels open to it by which to return as a surface current to the South; the southward flowing current would not have much of the westward bias on account of the impulse given in the opposite direction by inequality of surface. In the intertropical region the same principles of action produce modified and conspicuously different results: the same modifications may be said to obtain throughout the Torrid Zone; but the peculiarities are, at any parallel of latitude, marked, in proportion to the proximity of the Equator: at this line the eastward motion of the atmosphere is at its maximum rapidity, and the direction of the motion deviates the least from that of the surface it rests on—revolving constantly in one line, instead of fluctuating between different latitudes: the temperature has here the smallest variation;—the line having the smallest possible range of position in reference to the sun: the hygrometric condition is as constant as the thermometric: the changes in the thermometric and hygrometric conditions depend upon elevation instead of upon latitude: the two systems of currents on the two sides of the line meet at the line, and neutralize each other,—a zone of stagnation being, thus, constituted: under all these circumstances the barometer scarcely varies its reading at the different seasons of the year.

The conditions pertaining respectively to the two zones would give an equatorial limit to the extratropical system nearly coincident with the polar limit of the intertropical system; but each would necessarily extend itself till it met the other, and where the two currents met, each stopping and returning, stagnation would necessarily ensue, as regards north and south movement; and there would be stagnation as regards east and west movement, because these two movements would neutralise one another at the same intermediate line;—thus the calm of the "*horse latitudes*" is accounted for.

The winds from the S.W. quadrant of the compass prevail over those from the other quadrants during two-thirds of the year: there is no one day in the year (taking the average values for the sixteen years) on which the S.E. winds prevail over the others.

The S.W. winds prevail on 242 days in the 365. The N.E. winds prevail on 72 days. The N.W. winds prevail on 40 days.

The periods of the year in which these three winds respectively prevail are as follow:—

S.W.	N.E.	N.W.
Jan. 5 — Jan. 27	Feb. 9 — Feb. 12	Jan. 28 — Feb. 7
Feb. 13 — Feb. 21	Feb. 27 — Mar. 24	Nov. 24 — Dec. 6
Mar. 26 — Apr. 9	Apr. 10 — May 7	Dec. 19 — Jan. 3
May 10 — Aug. 31	Sept. 1 — Sept. 14	
Sept. 16 — Nov. 23		
Dec. 7 — Dec. 18		

The mean daily frequency (not prevalency) with which the wind flows from each of the four quadrants, stated in arithmetical proportionate values, for the year is as follows: *viz.*, N.E. $\frac{3.4}{16}$, S.E. $\frac{2.1}{16}$, S.W. $\frac{5.2}{16}$, N.W. $\frac{3.9}{16}$, — $\frac{1.4}{16}$ being the value for variables.

In addition to the periods of prevalence for the three prevailing winds, we may assign to each of the three, periods of *extra* prevalence,—periods which, from the intensity of their character, may especially be relied upon for permanency and significancy—the specific meteorological tendency of the time being more strongly indicated in these selected periods. The rule for the selection of the days to constitute these periods will be, to include all those which have a value for frequency exceeding the mean value of all the periods of simple prevalence, in each of the respective quadrants;—putting aside those below the means as having a more mixed character. These select periods may be called periods of excessive, or intense, prevalence. As the S.E. wind never prevails, it cannot be dealt with in this way; but the periods of excessive *frequency* may be given for this quadrant, and so complete the view as given in the Table below:—

S.W.	N.E.	N.W.	S.E.
Periods of intense Prevalency.	Periods of intense Prevalency.	Periods of intense Prevalency.	Periods of intense Frequency.
Jan. 16 — Jan. 25	Mar. 2 — Mar. 21	Jan. 28 — Jan. 31	Dec. 29 — Jan. 16
May 31 — Aug. 26	Apr. 11 — Apr. 25	Nov. 22 — Dec. 6	Feb. 18 — Feb. 22
Sept. 27 — Oct. 8	Sept. 3 — Sept. 10		Mar. 7 — Apr. 7
			Apr. 15 — May 5
			May 20 — June 3
			Aug. 31 — Oct. 1
			Oct. 26 — Nov. 10
			Dec. 12 — Dec. 20

The S.W. wind is the normal, proper wind for the locality; at least during a great part, and the warmer part, of the year: it prevails constantly for long periods; and the months, June, July and August constitute one of the present categories for this quadrant. During the first period—(Jan. 16—25) deposition has probably abated for a short time in the arctic regions, in consequence of the sun's rays reaching the atmosphere, but augments again afterwards as the quantity of vapour accumulates from the South, and the temperature of the earth subsides at the spot.

The one characteristic which obtains for all the periods in the column for N.E. winds in this Table is the excessive air pressure which accompanies them: this pressure for the successive periods amounts to, 29.842 in., 29.724, 29.755,—the annual mean value being 29.693: the *atmospheric* pressure for the second period of the three is below the annual mean. The first period is connected (as has already been suggested) with the extreme cold of the extreme North,—deficiency of vapour being a marked characteristic. The second period has been associated with low temperature and copious deposition in the north-west; defect of vapour obtains in this period also: the first of these two periods is in the midst of the Period of Aëration; the second is in that of Evaporation.[1] The third period is associated with deposition in the East and North-east; the vapour pressure is .0835 above the mean, and the atmospheric pressure .154 above the mean: the wind in this period does not appear to be much to the N. of East, as the value for the S.E. during the period is 2.8 (the annual mean being 2.1), and there is only one day in the year which gives a higher value for this quadrant than September 13.

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[1] See Page 80.

The two periods in the column for N.W. winds are each characterised by profuse deposition in the arctic, or high northern, latitudes (according to the theory adopted.) Indications were observed between November 13 and Nov. 22 of the northern regions becoming the site of principal deposition: on Nov. 20 the sun's rays leave the latitude of the magnetic pole, and this would probably be soon followed by the max. deposition. On Jan. 21 the sun again returns to this latitude, and it is probable that the min. temperature for that neighbourhood, and consequently for the whole of the arctic region, and indeed for the hemisphere, occurs at about that date,—probably somewhat later—and this would be attended with profuse deposition.

The S.E. winds being of an exceptional character, and more accidental, they recur frequently through the year for short intervals. June, July and August are particularly exempt, owing to the strong S.W. tendency. September is peculiarly liable to this wind, owing to the active deposition in the East and South-East.

The investigation of the present subject of discussion has appeared to be assisted by considering the direction of the wind in connection, more especially, with the atmospheric pressure: and the arrangement will be adopted of taking successively, the periods of prevalence for each of the three quadrants, and dividing each of these periods into two categories, *viz.:* one for excessive, and one for defective atmospheric pressure.

The 242 days of S.W. winds are accompanied, on the average, with an atmospheric pressure below the mean; but there are an equal *number of days* with excessive, and with defective, pressure. The 72 days of N.E. winds are accompanied with a pressure considerably above the mean, and the days of excessive pressure are to those with defective pressure as 4 to 3. The 40 days of N.W. winds are accompanied with a pressure slightly above the mean, but the days of excessive pressure are less numerous than those with defective pressure, in the proportion of 3 to 4.

Wind.	Atm. Press.	Days of Low Press.	Days of High Press.
S.W.	−.0121	122	120
N.E.	+.0398	31	41
N.W.	+.0024	22	18

The atmosphere of the customary S.W. wind, proceeding from a circumferential area towards a central point, at a low level, must increase, as it progresses, in its vertical measurement, and this must tend to ensure its speedy return towards the South, in some eastern longitude on the same low level, and the equilibrium of the atmosphere would thus be maintained (independently of other disturbing agents) without any great derangement. The N.E. wind pursuing an unusual, irregular course, may be regarded as incidental, and would prevail only partially; it would not proceed far, probably,—frequently not far beyond the English Channel—before it would meet with the customary S.W., and, as a consequence of the collision, an accumulation of atmosphere would ensue, and increased atmospheric pressure. The N.W. wind would not come into such direct collision with the S.W.; but, though indirect, the effect is no less manifest.

The **S.W.** winds prevail cotemporaneously with a low atmospheric pressure, in the periods included in the first column of the following Table;—the second column including the periods of high pressure.

	Periods of Low Pressure.	Periods of High Press.	
1	Jan. 5 — Jan. 27	Feb. 13 — Feb. 21	1
2	Mar. 26 — Apr. 9	May 26 — July 29	2
3	May 10 — May 25	Aug. 13 — Aug. 31	3
4	July 30 — Aug. 12	Sept. 16 — Sept. 21	4
5	Sept. 22 — Nov. 1	Nov. 2 — Nov. 14	5
6	Nov. 15 — Nov. 23	Dec. 7 — Dec. 13	6
7	Dec. 14 — Dec. 17		

The periods in the first column correspond better with the periods of intense prevalence for this quadrant, than those in the second column: the first and fifth periods have the closest correspondence, and are therefore important ones for the investigation of the point under present consideration; and with these two periods may be associated the sixth, on account of its very low atmospheric pressure: these three periods may be selected as indicating the law which determines the one characteristic of the whole category,—that of low pressure. The mean defect in the atmospheric pressure for the whole category is .055 in.; that for the first period is .044, that for the fifth .079, that for the sixth .070: these three periods have another characteristic attaching to them,—they are each periods of very abundant fall of rain;—the annual mean value being .090 in., the value for these three periods is, respectively, .117, .159, .132. It appears to be very evident from this, that it is the deposition which is the immediate cause of the low atmospheric pressure, and not either the direction of the wind, or the quantity of vapour in the atmosphere: the mean *vapour* pressure is below the annual mean value, for the first and sixth periods,—above it for the fifth. Low atmospheric pressure has no tendency to *produce* deposition, but deposition has evidently a tendency to produce low atmospheric pressure: the low atmospheric pressure, as a matter of observation, frequently *precedes* deposition, because deposition is local, and, at the first, distant; whilst the effect upon pressure is more general, and is observed at an early period. The S.W. wind has no direct tendency to produce deposition, but it is highly probable that deposition—at the site of observation—has a direct tendency to produce and maintain a S.W. wind,—the South-west being the main source of the vapour which undergoes deposition.*

The periods of excessive atmospheric pressure have no well marked correspondence with the periods of intense S.W. prevalence; neither have they with the periods of intense prevalence for either of the other quadrants. The feature which characterises these periods of excessive atmospheric pressure is the excess that obtains in the vapour pressure: when the atmospheric pressure is in excess there is very generally a still greater excess in the vapour pressure;—thus in the 2nd, 3rd, and 4th periods of this category, which involve together 90 days, there are only two groups of five days each in which the *excess* of vapour pressure does not exceed that of the atmospheric pressure, and the occurrence in one of these groups is to be accounted for by the approach of N.E. wind, and this group may therefore be associated with the first period of this category. In the first period, which includes nine days only, the vapour pressure is greatly in defect: the excess in the atmospheric pressure is to be accounted for by these nine days intervening between periods of N.E. and N.W. winds: the atmosphere seems to be converging to one point from each of the three quadrants: from February 7 to February 28 no one of the three quadrants obtains any marked preponderance over the others; but each, in turn, gains the ascendancy for a few days; and the whole of this interval may be regarded as illustrating the effect of converging currents, rather than as illustrating the laws pertaining to any one current:* the atmospheric pressure is above its mean during the whole of this interval, with the exception of the two first days, and the excess (which by the way attains its maximum just in the midst both of the interval alluded to, and of this first period of S.W. wind) must be attributed to the convergence of the currents, and in no degree to the prevailing direction of the wind or the proportion of vapour in the atmosphere. Having disposed of this first period which is marked by defect of vapour, we return to the periods illustrative of the law *usually* determining the excess of atmospheric pressure during a S.W. current: the mean excess of atmospheric pressure for the 90 days specified above is .0316 in.: and that for vapour pressure is .0987: the proportion of vapour in the atmosphere is 1 in 80. The excess of atmospheric pressure in these three periods may, then, safely be attributed to the great excess of vapour in the atmosphere. The fifth period is not marked by an excess of vapour pressure, this having fallen below its annual mean just at the commencement of this period; and, on the other hand, the atmospheric pressure rose above its mean just at the same time, and neither varies much from its mean: so, in regard to the winds they are nearly evenly balanced; the S.W. has the preponderance, but it is below its annual value; and each of the other three quadrants have values above the annual mean, the S.E. having its max. value for the year on Nov. 3; the force of the wind, too, has a very low value, reaching its min. for the year just after the termination of the period: the period has already been remarked upon (in the discussion of Section XI.) as being emphatically one of equilibrium, stagnation, and humidity; and it is very probable that although the S.W. prevails at the site of observation, currents from the other quadrants converge towards, and flow by the side of, or above, though they do not reach, the site: and thus favor both the quiescent state, and the high pressure of the atmosphere. In the sixth period the vapour pressure is low, but the atmospheric pressure is only .009 above the mean: the S.W. winds are but little above their mean value; whilst the N.W. are considerably above the mean. The rule then (with only trifling exceptions) is, that excessive atmospheric pressure with a S.W. wind is dependent upon excess of vapour in the atmosphere.

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* The S.W. wind has no *direct* tendency, but it has one *indirect*, to produce rain: it has a *direct* tendency to augment the quantity of vapour in the atmosphere: but, supposing this to proceed to the point of saturation, the direct effect of this is to preclude further evaporation, and, therefore, does not lead to precipitation; and further, in proportion as the point of saturation is approached, vaporisation diminishes; and, moreover, the vapour does not accumulate in any circumscribed space, but diffuses itself rapidly through the atmosphere,—so that increment of vapour seldom, if ever, reaches the point of saturation except immediately above the surface of the earth. When a large proportion of vapour exists in the atmosphere, another agency is still required to determine the occurrence of precipitation, and however great the proportion may be, this does not necessitate the intervention of the agent: diminution of temperature is here an efficient agent, and it is commonly the *direct* and immediate cause of precipitation; the effect may be produced in consequence of cold atmosphere being brought to bear upon a warmer atmosphere either copiously or moderately charged with vapour; and thus a northerly wind may be the *direct* cause of rain rather than the southerly;—or the effect may be produced in consequence of the vapour progressing to a colder region, and this is frequently effected by its ascending merely to a higher level.

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* There are three consecutive days of N.W. wind in this intervening period which have not been inserted in the Table at page 99.

The **N.E.** winds prevail cotemporaneously with a low atmospheric pressure in the periods included in the first column of the following Table;—the second column including the periods of high pressure.

	Periods of Low Press.	Periods of High Press.	
1	Mar. 18 — Mar. 24	Feb. 9 — Feb. 12	1
2	Apr. 10 — Apr. 17	Feb. 27 — Mar. 17	2
3	Apr. 22 — May 7	Apr. 18 — Apr. 21	3
		Sept. 1 — Sept. 14	4

The periods in the first column do not correspond with the periods of intense prevalence for this quadrant: this implies that there is a tendency to high pressure during the prevalence of N.E. winds. Each of the periods in the category of defective pressure show a considerably greater defect in the vapour pressure than in the atmospheric pressure: the mean excess of this defect for all the three periods is .0126 in.; there are, however, in each of the periods exceptional days in which the defect is most in the atmospheric pressure; *viz.*, the last day of the first period, the two first days of the second period, and the six last days of the third period. The last exception is referable to the fact that it occurs at the close of the season subject to N.E. winds at this part of the year; the *vertical* circulating current now withdrawing its southern limits to a higher latitude: the subsidence and retrocession of the N.E. takes the initiative, and thus produces a temporary deficiency, notwithstanding the vapour increases somewhat rapidly, and the S.W. branch of the horizontal circuit occupies the ground vacated; but the latter is no sooner established as the proper wind of the season, than it fills the void effectually, and the pressure begins to increase upon the day of its establishment. In the first period, diminution of the atmospheric pressure commences sixteen days before the N.E. ceases, and then, upon the occurrence of S.W., a slight increase of pressure ensues, which continues only for a few days, but is greater in amount than the cotemporaneous increase of vapour. The second period of low pressure occurs at the commencement of a month of N.E. wind, and though the pressure increases for nine days after, (attaining the annual mean on the eight day) as well as for two days before the N.E. sets in, it diminishes again after this, and ushers in the third period on the twelfth day;—a four day's interval of high pressure thus occurring in the midst of a long period of low pressure: from this it may be inferred that the N.E. wind has no great tendency in itself to occasion high pressure. The third period has already had an explanation given for the low pressure of the last six days: the ten first days are sufficiently accounted for in common with the other two periods by the low vapour pressure that obtains: the mean defect in the atmospheric pressure for the ten days is only .0086, whilst that for the vapour is .0347. The second and third periods, together with the intervening short period of high pressure, may be viewed together as possessing features of interest as regards the laws for the direction and force of the wind, and the pressures of the atmospheric fluids. It has already been suggested whilst treating of the third Section that the phenomena at this time depend upon active deposition in the North-east—probably in the N. of Europe; and the progress of events will now be detailed in connection with this assumption: on the 10th of April the increment of vapour pressure subsides to 0, owing to the great drain upon the vapour; this is accompanied—as might be expected—with a check to the increment of atmospheric temperature, which reaches a min. value of .10, also on the 10th: but whilst the increment of vapour is checked the air pressure *diminishes* and it exhibits a min. value on the 7th,—the air being carried along with the vapour to the site of deposition is not reproduced, as the vapour is: the atmosphere being thus drawn to the point of deposition, it gives direction to the atmospheric current, and so affords an indication as to the site of deposition; on the 10th the N.E. wind sets in,—supplanting the S.W., which had previously prevailed: now, prior to April 3 the drain upon the vapour gives an increased impetus to the S.W. current, the daily values augmenting from 2.28 on March 24, to 2.54 on April 3;—then, as the return current approaches, the values subside, and on the 7th, when the atmospheric pressure is at a minimum, the force is 2.5, and upon the arrival of the return current on the 10th the force is reduced to 2.47; and the atmospheric pressure, now increasing, attains on the 18th a value above the annual mean: the pressure of the N.E. against the S.W. wind subsides again on the 20th, the values for the N.E. diminishing on and after this day together with the values for atmospheric pressure; the latter falling below the annual mean again on the 22nd: as the deposition abates and the temperature rises, the N.E. tendency subsides, the force of the wind sinks to 2.06 on the 26th, and the vapour accumulates so as to exhibit an increasing augmentation of pressure for April 27—May 7; the last date being that on which the N.E. retires from the field—the S.E. increasing in *its* values from April 12 unto April 26.* There is no room to doubt, that the low vapour pressure is the principal cause of the defective atmospheric pressure belonging to this category.

The periods of high pressure with N.E. winds do correspond very much with the periods of intense prevalence for this quadrant. The four days constituting the first period are not included in the periods of intense prevalence, and they show but slight excess of pressure; but they are cotemporaneous with great deficiency of vapour pressure: intervening, as these days do, between periods of the other two quadrants for wind, the high pressure may well be attributed to the convergence of the three. The second period appears to set in with opposition to the N.E., from tho S.W., for, as it gains in prevalence, the force of wind is at a low value, and the atmospheric pressure increases, but as it pushes the S.W. before it and gains a thoroughfare for itself the force of wind increases, and the pressure diminishes, and continues to diminish for many days, and falls below the mean pressure seven days before the conclusion of this quadrant's prevalence: and not only does the pressure fall below the mean, seven days before the cessation of the N.E., but it is above the mean fourteen days before the commencement of the N.E., during a S.W. wind. The third period occurs in the midst of a period of intense prevalence, but it also occurs in the midst of a period of defective pressure; it includes four days during which the pressure gets a trifle above the mean value, and it depends upon the N.E. tendency gaining its max. value on the 19th, whilst the opposition from the S.W. reduces the force of the current below its mean annual value. The fourth period corresponds with a period for intense prevalence, —the period of high pressure being far from coterminous with the whole period of N.E. wind occurring at this time: the excess of pressure commenced 19 days prior to the setting in of the N.E., whilst the S.W. prevailed: the pressure had been *increasing* for 25 days *prior* to the commencement of the N.E., the excess of pressure continued for six days *after* the subsequent return of the S.W., and the max. rate of increase of pressure occurred five days before the N.E. set in. This period has been pretty fully discussed under the head of Section VIII., where it seems to be shown that the high pressure is the result of the convergence of two opposite currents: the argument rests upon much the same principles as it does for the third period, but it appears that the N.E. current in this case proceeds further beyond the site of observation than it does in the former: the force of the wind subsides upon the appearance of the N.E. wind and continues to diminish during its presence, and upon its retrocession the force increases again, and the atmospheric pressure diminishes. Both the important periods in this category commence with high pressure whilst the N.E. is contending with and displacing the S.W., and then, as their own tendency to continuance abates, the pressure subsides and the S.W. returns. The conclusion to be arrived at seems clearly to be, that the high pressure accompanying the N.E. wind depends upon its pressing against the S.W.; and it appears that what directs the return N.E. current to the site of observation is not at the same time destructive of the tendency of the S.W. to the same spot, but that the S.W. is displaced by the superior strength of the N.E., and is then obliged to continue its course at a higher level;—but the displacement is probably partially in a horizontal, and not altogether in a vertical direction.

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* It is shewn in the Appendix that the max. deposition for the year at the magnetic pole occurs on April 13; and it is probable that the very abundant deposition in this western neighbourhood concurs with the conditions which obtain in the eastern longitudes in producing the phenomena noticed above,—more especially the great drain upon the vapour, and the high values for S.E. winds.

The **N.W.** winds prevail cotemporaneously with low atmospheric pressure in the periods included in the first column below;—the second column including the periods of high pressure.

	Periods of Low Press.	Periods of High Press.	
1	Jan 28 — Feb. 7	Dec. 5 — Dec. 6	1
2	Nov. 24 — Dec. 4	Dec. 19 — Jan. 3	2

The second period in the first column, and the first in the second column form the principal periods of intense prevalence for this quadrant. The commencement of the season of N.W. winds is preceded by the establishment of the wet season in the N.W. regions: the N.W. winds increase in their frequency from the beginning of November: the atmospheric pressure begins to decline on the 10th; on the 15th the S.W. begins to increase in frequency, and two days after, the force augments;—and the 15th is the date that has been fixed upon for the northern regions becoming the *principal* site of deposition: it appears therefore that the deposition in the north draws upon the S.W. branch of the horizontal circuit pertaining to the neighbourhood of the site of observation at an early period, and thus reduces the atmospheric pressure; and that subsequently the site of principal deposition recedes further to the North,—to Greenland, probably, first, and finally to the midst of the extreme north latitudes of America—and the consequent return current from these extreme points reaches the site of observation on November 24, and the collision between the N.W. and S.W. currents gives rise immediately to augmenting atmospheric

pressure;—the value increasing the day after the N.W. sets in, and bringing the pressure to a value above the mean. The increasing frequency of the N.W., which began with the 1st of the month, continues till Dec. 2; and this is at the cost of the S.E., which diminishes in frequency from the 3rd to the 30th; and of the N.E., which diminishes from the 13th to the 24th: the principles thus laid down for the explanation of the low pressure in the second period, apply better to the first part than they do to the last part of the period; but the defect in the vapour pressure during the last four days affords satisfactory explanation here: the defect in the vapour pressure for these days is .0441 in., and that for the atmosphere only .0205. Whilst the N.E. closes its season of prevalence with low pressure, the N.W. *commences* its season under this condition; and, indeed, the same tendency is observable at the close of each period of N.E. wind with high
commencement even

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	Periods of Low Press.	Periods of High Press.	
1	Jan. 28 — Feb. 7	Dec. 5 — Dec. 6	1
2	Nov. 24 — Dec. 4	Dec. 19 — Jan. 3	2

and the united currents thus give rise to a great depth of atmosphere. There seems to be no room to doubt that the high pressure of this period depends upon the converging, but collateral, northerly and southerly currents producing a deep—or rather high—stream of atmosphere.

EASTWARD BIAS.

The S.W. is by far the most prevalent of the four quadrants of winds; and in this quadrant the westerly influence preponderates over the southerly: the wind from the W.S.W. point is nearly twice as frequent as that from the S.S.W.,—the proportion being 362 to 192: the disproportion is greatest in July and August, the W.S.W. being more than four times as frequent as the S.S.W. in these months: on

January and December the disproportion is very small, as the annexed Table will show. The N.E. winds show a similar tendency to suffer deflection *towards* the East during the hot—or rather during the early hotter months: if the values for May, June, July be grouped in one category, and those for the remaining nine months in another; it will be found that the N.N.E. wind is 2½ times more frequent than the E.N.E. in the former category; and the E.N.E. has slightly the preponderance in the latter.

Month.	S.S.W.	W.S.W.	N.N.E.	E.N.E.
Jan. ..	24	25	14	15
Feb. ..	8	28	16	15
March	16	21	14	24
April ..	13	27	16	16
May ..	21	32	30	12
June ..	23	38	18	7
July ..	11	46	9	4
August	10	46	11	14
Sept. ..	12	16	11	20
Oct. ..	16	31	14	16
Nov. ..	16	23	17	11
Dec. ..	22	29	24	15

This bias in the movement of the atmosphere may possibly depend upon the tendency of the atmosphere to flow from the vapour yielding gulph stream of the Atlantic, and to the heated dry land districts of central Europe.

The S.E. wind seems to occur, principally, as a transition wind; that is to say, the wind falls into this quarter temporarily, as it comes in the route the wind takes in shifting from one point to another: the exceptions to this rule may be looked for at those dates when the S.E. exceeds in a marked degree its mean value for frequency; upon these occasions some other specific agent may be suspected to be in the field. The transitional occurrence of the S.E. is most constant upon the occasions of the wind shifting from N.E. to S.W.; but it obtains conspicuously, also, in the shifts from S.W. to N.E. Even in the shifts between the N.W. and S.W., the wind shows a preference to moving through the East rather than the West: if the shift is from N.W. to S.W., a leaning is first observable to the N.E., and subsequently to the S.E.; if it is from S.W. to N.W., the leaning is first to the S.E., and subsequently to the N.E. There are three dates of markedly high values;—*viz.*, November 3, September 13 and March 30: the first of these dates falls on the 49th day of a period embracing sixty-nine days on which the S.W. is the quadrant, and the W. the semicircle, from which the wind blows: this period is preceded by one in which the wind is N.E., and N.; it is succeeded by one in which the wind is N.W., and W. September 13 is the 13th day of a period of N.E., and N. winds: a long period of S.W., and W. sets in on the 16th,—these winds having also prevailed for a long period prior to September. March 30 is the 6th day of a period embracing fifteen days of S.W., and W. winds: the period is preceded by a long one of N.E., and N., and is succeeded by another of the same nature.*

COLLATION OF THE FOUR SEMICIRCLES AND FOUR QUADRANTS.

The following Table exhibits the order of frequency; also the relative frequency, with which the wind flows from the eight different directions indicated. The letters indicating the cardinal points refer to the semicircles they represent. The values belonging to the semicircles are necessarily intermediate between those belonging to their respective quadrants.—See Table XXII., and annexed explanation.

The S.W.	being as	2.60	in 8
W.	is	2.28	,,
N.W.	,,	1.96	,,
N.	,,	1.84	,,
S.	,,	1.83	,,
N.E.	,,	1.71	,,
E.	,,	1.38	,,
S.E.	,,	1.05	,,

The values, as they are introduced in Table XXII., and which will be used in the following statement, are given in such numbers as bear the proper proportion to 32.

The equality of the N. and S. contrasts here with the inequality of the E. and W. semicircles,—the excess in the S.W. value counter-balancing the defect in the S.E.

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* Each of these dates is associated with a period of abundant deposition at the magnetic pole, as is shewn by Table II., Appendix C.

The next Table gives the months and Sections in which each of the eight directions exceeds its annual mean value.

Wind.	Sections.								Months.						
N.	1	2	3	4	8	10	11	12		2	3	4	11	12	
S.	5	6	7	9	10*				1	6	7	8	10		
E.	1	2	3	4	5	8	9	12	1	2	3	4	5	9	
W.	1	5	6	7	10	11			1	6	7	8	10	11	12
N.E.	1	2	3	4	5	8	12		1	2	3	4	5	9	
S.E.	2	3	4	8	9	10	12		1	3	4	5	9		
S.W.	5	6	7	9	10				1	6	7	8	10		
N.W.	1	6	7	8	10	11	12			2	7	8	10	11	12

On January 4,—date of the preliminary min. temperature—the S.W., W., and N.W. winds are each at the value $\frac{8.4}{32}$; whilst the N.E., E., and S.E. are, respectively, 7.2, 6.4, and 5.6; the N.E. at this time attaining a casual min. value. On January 25,—date of max. preliminary rise of temperature—the S.W., W., and N.W. are 11.8, 10.8, 9.8; the W. at this time attaining a casual max. value; whilst the N.E., E., and S.E. are 6.0, 4.3, 2.6, each of these three being a casual minimum. On Feb. 11,—date of min. temperature—the N.W., N., and N.E. are 8.4, 8.7, 9.0; the N. being only 0.3 short of its maximum, and the N.E. at a casual maximum; whilst the S.E., S., and S.W. are 3.2, 6.0, 8.8. On May 5,—date of mean temperature,—the several directions are each near their mean values: the N.E. has the highest value, and departs the most from its mean; the S.W. ranks next in these particulars; and the S.E. has the lowest value. On July 11, the direction of the wind serves in some measure to account for the check that occurs in the increment of temperature at this time; the N.W. attains a casual maximum 9.4, and the S.W. a casual minimum 13.0. On August 4,—date of max. temperature—the S.W. is greatly in excess of its mean value, and preponderates greatly over the other winds: the S., S.W., and W. are 9.0, 15.2, 11.4; the S.W., and W. attaining their max. values for the year: the N., N.E., and E. are 6.0, 4.4, 3.6. On October 20,—date of mean temperature—the several directions are even more near to their mean values than at the vernal mean; but it is curious that in almost every instance the excess and defect—as to mean value—are reversed at the two periods; the departures from the means standing thus—

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* When the same division of the year is represented as giving an excess to two opposite directions this arises from the two being evenly balanced,—more than one place of decimals being required to show the difference.

	N.	S.	E.	W.	N.E.	S.E.	S.W.	N.W.
Vernal Mean.	+0.1	−0.7	+1.3	−1.8	+2.2	+0.4	−1.8	−1.8
Autumnal Mean.	+0.1	0.0	−0.9	+1.1	−1.4	−0.4	+0.4	+1.8

On December 6, and on January 18,—dates upon which a remarkable increment of temperature occurs in association with similar positions of the sun—the S.W., and W. are at a high value; being at the former date 10.6 and 10.7, at the latter date 12.4 and 9.3.

In the Period of Aëration, *viz.*, Section II. (Feb. 24—March 22), the N.E. has the highest value, and this is 2.6 above its mean: on March 8,—date of max. intensity—this wind is at a casual maximum, 9.8, which is 3.0 above the mean. In the Period of Evaporation, *viz.*, Section IV. (April 19—May 18), the N.E. has the highest value, which is 2.5 above its mean: on April 21,—date of max. intensity—the N., N.E., and E. have the highest values; the N. value being 8.1, which is 0.7 above the mean; the N.E. being at its maximum, 10.8, from April 17 to April 20; the E. being also at its maximun, 8.0, from April 19 to April 22. In the Period of Vaporisation, *viz.*, Section VII. (July 21—Aug. 19), the S.W. has the highest value, and is 3.6 above its mean: on August 3,—date of max. intensity—the S., S.W., and W. have the highest values; the S. being at its maximum, 9.2, on August 6; the S.W. at its maximum, 15.2, on the 4th; the W. at its maximum, 11.4, on the 2nd. In the Period of Condensation, *viz.*, October, the S.W., and W. have the highest values; the S.W. being 0.9 above its mean, the W. 0.8 above its mean: on October 3,—date of max. intensity—the S., S.W., and W. have the highest values; the S. being 1.5 above mean, the S.W. 3.2 above mean, the W. 0.9 above mean.

The values for the N. semicircle preponderate over those for the S. semicircle, from January 24 to March 27; and from April 7 to May 17; as well as in the four shorter periods: the number of days included in this category is 192. The values for the S. semicircle preponderate over those for the N. semicircle, from May 18 to August 26; as well as in five shorter periods: the number of days included in this category is 169. The values for the E. semicircle preponderate over those for the W. semicircle, from April 14 to May 2; as well as in two shorter periods: the number of days included in this category is 39. The values for the W. semicircle preponderate over those for the E. semicircle, from May 3 to September 2; and from September 15 to March 7; as well as in one shorter period: the number of days included in this category is 323.

STATISTICS OF PARTICULAR PERIODS.

With a view to investigating the laws respecting the direction of the atmospheric currents, the precise Point of the compass from which it flows has been ascertained for those particular periods of the year which have some marked feature belonging to them. The method pursued in this investigation requires some explanation: and, in the first place, the Point of the compass from which the wind shows the strongest tendency to blow at any given period, will, for the sake of brevity, be denominated the *strong Point*:—the periods selected for examination are those which exhibit a marked preponderance in some one quadrant over the others; but several of the periods possess some additional characteristic:—nine consecutive days are taken at the respective culminating points of preponderance; and the number of days that the wind blows from each Point of the compass, on the successive nine dates, during the sixteen years, is ascertained:—the values being thus determined for each Point, the one is adopted as the *strong Point* which gives the highest number of days in combination with the two proximate Points on each side; and under this arrangement the strong Point does not generally happen to be identical with that which exhibits the max. value in the whole series, taken singly:—each group of nine days will have a central date assigned to it; and this date is generally the culminating day for preponderance (as computed upon the sixteen years); but, occasionally, some other of the nine days is substituted for this day of culmination, for the sake of adopting one possessed of some special characteristic. It is by no means the case that the values for the respective Points decline progressively from the strong Point towards the opposite side of the circle; it is, on the contrary, very frequently the case that the Point of *second strength* is found at, or near, the opposite point of the circle, though in other cases a well marked Point of second strength is separated from the strong Point by a quarter of the circle.

The direction of the wind, at the site of observation, is much more controlled by local peculiarities of the terrestrial surface than by any conditions that may be supposed to give a law of general application; and the same may probably be said of the whole of Europe, if not of the north temperate zone. The western districts of Europe are interposed between the Atlantic on one side, and extensive land districts including extended plains on the other: and these two distant regions, having the site interposed about mid-way, constitute poles of action,—an action corresponding to that which is so constant and regular in the tropical regions; but with the correspondence there is this marked difference, *viz.*, whilst on the one hand, there is always between the tropics a central zone of high temperature, and in the tropical latitudes a zone of comparative low temperature, so that the two regions bear constantly the same relationship to one another;—on the other hand, the two regions in the north temperate zone exchange their polar characteristics periodically. Whilst temperature is rising, under the increasing influence of the sun's rays, the heat augments in the land region much more rapidly than in the sea region; and the former becomes the pole of high temperature, and it becomes at the same time the region of min. humidity, and probably even of min. dew-point: the latter region, whilst it retains a comparatively low temperature, becomes the region of max. humidity, and of a value for dew-point certainly very *high:* the relationship between the atmospheric and dew-point temperatures is, thus, very different in this large portion of the temperate zone from what it is in by far the greater part of the torrid zone: when the temperature declines, it does so far more rapidly in the land region than it does in the other; and, indeed, it *begins* to decline in the one whilst it is still augmenting in the other; and it results from this that at the time the Atlantic acquires its max., and a very high temperature in latitudes but little South of the English Channel,—the Gulf stream being the site of the greatest intensity of the condition—the land region is simultaneously subjected to a great reduction of temperature: and this reversed condition in regard to temperature is accompanied with a reversal of the atmospheric current—to the extent at least that limited local observation, at the surface of the earth, could determine; the direction of the wind changing from about two Points south of W., to about three Points north of E: during the season of augmenting temperature, the atmospheric action dependent upon temperature and vapour is progressive and gradual, and the western flow is maintained in force for a very long period; but when the temperature declines and precipitation sets in, these events occur more abruptly, and the latter interferes materially with the movements that would obtain under the agency of temperature alone, and the direction of the wind, consequently, becomes much more variable. In the Torrid Zone, the region of *high* temperature is also, and it is permanently, the region of precipitation,—precipitation being here effected as soon as the almost saturated atmosphere is subjected to a sufficiently low temperature in its ascent to a higher level; and alternations and variations corresponding to those of the temperate zone are consequently not observed.

The alternative as to the eastward or westward flow of the atmosphere must depend a good deal upon the *rapidity* with which it moves in the direction of the

Poles: if the atmosphere be transferred rapidly from a lower to a higher latitude, it must arrive at the higher latitude with more of the eastward bias which it acquired in the lower latitude, than it would have under a slower rate of such transference: supposing the atmosphere to remain stationary at any latitude, it would evidently by degrees acquire a motion approaching to that of the surface on which it rests: and, consequently, in the case of its proceeding from a *higher* latitude to the one of rest, it would lose much of its original relative eastern bias; and in the case of its arriving from a *lower* latitude, it would entirely lose its relative western bias and acquire an eastern: the turn of the scales, therefore, as between East and West, might be determined by the rate of the Polar movement: this view of the matter is supported by facts,—the two groups which are calculated to illustrate the point each affording a favouring indication—though it must be admitted that the values giving this support are of no great weight: upon comparing the recorded force of the wind for the days with a wind on the east side of S. in the group of April 2, with that for the days with a wind on the west side of S., the E. gave a mean force of 1.84, against 1.94 for the W.; and upon making a similar comparison with the particulars belonging to the group of September 3,—the N. being here the point of separation—the E. gave 1.82, against 1.32 for the W.: the result of these comparisons could not be expected to be very marked considering the many complications that might interfere; moreover, the evidence at command was not calculated to elicit the full amount of the difference, because, the force of the wind had been noted with only three degrees of force, and of course the intermediate value was the one that most commonly came into the calculation on both sides. The great prevalence of S.W. winds is in favor of the received doctrine as to the impetus given to the atmosphere by the revolving motion of the earth, but it is quite opposed to the theory of a flow from the Equator to the Pole: the gradual veering of the wind to the W. Point, and the close approximation to this Point exhibited by the group for October, are very consistent with the theory of the western bias, but they demonstrate that some other potent agency must at least *concur* with this to produce the result: the atmosphere could not flow northward, upon the principle of flowing to a colder region, at a *low level;* and there is a fair presumption that the current which is flowing in proximity to the surface of the earth is seeking—not a colder, but—a warmer spot. It appears that upon general principles that have already been referred to, a N.E. tending current (supposing it to be flowing at a low level) would sooner or later reach a line where its northward progress would be arrested, and in the districts under review local peculiarities would conduce to the same result: if the current arrived at the latitude of arrest with a relative eastward motion,—due to the eastward movement of the earth being less rapid than that of the atmosphere at the time of its arrival—this would necessarily subside upon its northward progress ceasing, and even a revulsion would ensue together with a bias to the South—the pressure resistance to its progress being less on this side than on the North side. But the S.W. current of Europe is dependent (mainly) upon the heat of the inland districts towards which it is flowing; it would therefore maintain its eastward course until it arrived at the point of attraction, and being here in a state of rest it would ascend as at the Equator: it might then, having lost its eastward impulse, acquire a relative westward motion, and return at least as far as to the western districts of Europe, where the E. and even the N.E. wind, if it be felt during the season of these occurrences, is pretty sure to be oppressively hot; the current, however, would have a stronger bias to the northern and colder latitudes than to the southern and warmer, and would be likely therefore to keep to the N. of the English Channel: the plains to the westward of the Oural mountains being thus supposed to be the terminus of the S.W. current, there would probably be a strong cold south tending current from this range of mountains to the tropical latitudes which would contribute to counterbalance the S.W. efflux *from* these latitudes: the great bulk however of the western current probably ascends to the summit of the Oural mountains, and having there deposited a great portion of the vapour it had brought from the Atlantic, then returns on the eastern side of these mountains to the southern latitudes,—being now subject to the thermometric instead of the hygrometric law: this hypothesis would account for the insatiable thirst of the districts to the eastward of the site of observation,—the cold of the mountains continually abstracting from the atmosphere the vapour which the heat of the plains had caused it to absorb.

We may now proceed to the discussion of the several groups, individually:—taking them in the order of the dates, the first embraces the nine days, January 16—24, and the values for the different points are as given below: the strong Point is indicated by this type **6**, the Point of second strength thus 4, and the Point of lowest value thus 3.

January 20.	N.	N. by E.	N.N.E.	N.E. by N.	N.E.	N.E. by E.	E.N.E.	E. by N.	E.	E. by S.	E.S.E.	S.E. by E.	S.E.	S.E by S.	S.S E.	S. by E.	S.	S. by W.	S.S.W.	S.W. by S.	S.W.	S.W. by W.	W.S.W.	W. by S.	W.	W. by N.	W.N.W.	N.W. by W.	N.W.	N.W. by N.	N.N.W.	N. by W.
	1	1	7	8	4	3	5	2	1	1	0	3	1	0	3	4	1	5	17	**6**	8	**6**	4	6	2	3	7	3	7	2	4	4

The S.W. by S. is here the strong Point, the N.E. the Point of second strength, and the S.E. by E. gives the lowest value. This period is remarkable for the high temperature that intervenes between the two min. values for temperature: the nine days include those on which this temporary increment of temperature proceeds at its greatest rate: they occur during one of the great flows of the air constituent of the atmosphere to the northward—or at least during a great accumulation of this ingredient at the site of observation; it therefore appears highly probable that it is the momentum of the air that gives, or rather constitutes, the direction of the wind. On the 26th, temperature begins to fall again, on the 28th the S.W. is supplanted by the N.W.,—the latter flowing as an under current, whilst the former continues its course at a higher level: the air pressure continues to augment: the low lying current from the N. semicircle preponderates over the S. on February 7, attaining at this time one of its two highest values in the year; on the 9th the N.E. is the preponderating quadrant: on the 11th min. temperature occurs: on the 15th the air pressure reaches a max. value. It is to be further observed that the northward current being at this period of the year more dependent upon the *general* law than upon the local law, which comes into force subsequently, the direction of the wind is on the south side of S.W.; the direction of the current being now determined by the atmospheric momentum.

March 8.	N.	N. by E.	N.N.E.	N.E. by N.	N.E.	N.E. by E.	E.N.E.	E. by N.	E.	E. by S.	E.S.E.	S.E. by E.	S.E.	S.E. by S.	S.S.E.	S. by E.
	2	4	7	8	10	3	5	6	1	4	3	3	2	1	2	1

March 8.	S.	S. by W.	S.S.W.	S.W. by S.	S.W.	S.W. by W.	W.S.W.	W. by S.	W.	W. by N.	W.N.W.	N.W. by W.	N.W.	N.W. by N.	N.N.W.	N. by W.
	0	2	5	5	5	5	8	2	1	6	4	3	5	4	2	2

This group embraces March 3—11: March 8 is the culminating day of the Period of aëration: the N.E. is here the strong Point, and the next on the N. side is nearly on a par with it: the Point of second strength is the S.W.: the Point of lowest value is the S.S.E.: the revolving vertical current is therefore now established in full force, in that form which obtained as an exception to the rule before; that which was the rule before being now the exception: the prevailing alternations here do not affect the *line* in which the currents flow: the alternate *direction* depends upon, or consists in, the northern flow reaching, or not reaching the site of observation: the discrepancy of temperature in the northern and in the southern regions is such, that the southward under current is established in great force; and this is so notwithstanding an accession of air from the South occurs which, in vertical measurement, is without a parallel during the year: the N.E. quadrant acquires a great preponderance, and maintains it from February 27 to March 24; and the N. preponderates over the other semicircles during the same period: when the northward air-flow induces, or concurs in, a temporary establishment of a S.W. current, this quadrant has more of the W. bias in it than was shown by the former group. During the latter part of February a combination or succession of several meteorological conditions obtained, such as arctic deposition, arctic cold, increment of heat in the South, fluctuations and great increment in the air constituent; the direction of the wind was consequently subject to frequent changes, and no one quadrant or semicircle gained any great preponderance over the others: the period under present consideration is marked by a more harmonious combination of conditions, and more settled state of atmosphere; the established phenomena are those belonging to arctic cold and excessive influx of air; these conditions, though proper to the period of the year, lead by their excess to their own reversal;—first, the excessive accumulation of air subsides, by the upper as well as the lower current flowing to the southward; this, by lowering the pressure in the northern latitudes and raising it in the southern, puts a stop to the northern current on March 22, and the S.W. flows in; hesitation is observable in the *air* movement; it flows in again for a few days at the site and then resumes its outward flow, having found a channel for its southward course, possibly at a high level, probably over the land surface in the eastern longitudes,—the S.W. current still maintaining itself at the site: the efflux of air continues—as evidenced by the barometer—until April 8, when it appears that the atmospheric deficiency in the North is such that a *general* flow ensues in that direction.

April 2.	N.	N. by E.	N.N.E.	N.E. by N.	N.E.	N.E. by E	E.N.E.	E. by N.	E.	E. by S.	E.S.E.	S.E by E.	S.E.	S.E. by S.	S.S.E.	S. by E.	S.	S. by W.	S.S.W.	S.W. by S.	S.W.	S.W. by W.	W.S.W.	W. by S.	W.	W. by N.	W.N.W.	N.W. by W.	N.W.	N.W. by N	N.N.W.	N. by W.
	2	3	3	3	2	5	3	1	1	4	6		5	2	1	4	4	6	7	5	10	7	10	5	2	5	5	4	5	2	0	✓

This group embraces March 29—April 6. The S.W. is the strong Point: the S.E. by E. is the Point of second strength: the Point of lowest value is N. by W. The oscillations of the air do not now form a conspicuous feature in the meteorological changes, and perhaps this accounts in a great measure for the prevalent current not keeping to two opposite Points: the principal tendency of the atmospheric flow at this period, which is connected with a S.W. preponderance of no long continuance, is that from S. to N., without any evidence of a return current. The S.W. quadrant preponderates within a limited range, including the site, on March 26: the preponderance increases in value at the site and, no doubt, simultaneously extends its range, until April 1; but the accompanying efflux of air continues until April 8: as the air flows in again (with a rising barometer), and the S.W. current may be supposed to become general and a N.E. current at the same time to approach nearer to the site, the preponderance diminishes at the site, —the *early* preponderance here observed existing probably only at a low level and extending not beyond the sea and its immediate neighbourhood—and the preponderance is not maintained after April 9. It is a remarkable coincidence that although the wind turns to the S.W. on March 25, no impulse is given to the increment of the dew-point temperature; at the date given to this group the increment is considerably reduced, and on the 10th it sinks nearly to 0: there is, thus, strong evidence afforded that the vapour which must accompany the S.W. wind is lost by deposition at the site it flows to; that is to say in the northern latitudes both E. and W. probably of the site: it is difficult to say which of these agencies is most effective, *viz.*, the deposition in originating the S.W. current, or the S.W. current in originating the deposition; perhaps they have about equal weight. As the air pressure in the North approaches a mean value and the atmospheric oscillations northward subside, one element in the direct N. tendency is brought to a low value, and this favours the flow of the atmosphere from the E. side of S.; this gives a marked feature to the period, the S.E. attaining very nearly its max. value for the year on March 31.

APRIL 21.	N.	N. by E.	N.N.E.	N.E. by N.	N.E.	N.E. by E.	E.N.E.	E. by N.	E.	E. by S.	E.S.E.	S.E. by E.	S.E.	S.E. by S.	S.S.E.	S. by E.	S.	S. by W.	S.S.W.	S.W. by S.	S.W.	S.W. by W.	W.S.W.	W. by S.	W.	W. by N.	W.N.W.	N.W. by W.	N.W.	N.W. by N.	N.N.W.	N. by W.
	1	9	5	7	13	3	4	6	2	4	6	1	2	2	2	2	0	1	2	4	3	8	9	2	0	2	3	3	7	3	1	3

This group embraces April 14—21. April 21 is the culminating day in the Period of Evaporation. The N.E. by N. is the strong Point: the S.W. by W. is the Point of second strength: S. by E. is the Point of lowest value. The preponderating influence in giving direction to the current is, here, the low temperature in the North and North-east;—this being a return to the conditions that obtained in March—but whilst the N. semicircle shows a value below what it was in March, the E. exhibits now its max. value for the year, and the N.E. exhibits its max. value on the days April 17—20; from which it would appear that the pole of low temperature is now transferred to the northernmost latitudes of Europe: the influence of second potency in giving direction to the current is the high temperature in the South and South-west; and thus the current keeps nearly in one line between opposite points again;—the summer S.W. flow occasionally altogether displacing the N.E., or else, and this seems most probable, the under current from the N.E. occasionally recedes before the S.W., which is ready to occupy the ground whenever resistance to its so doing is withdrawn: this point has been put to a statistical test; it is found that the mean atmospheric pressure for all the days with a N.E. wind in the sixteen years, during the period April 10—25, is 0.3 in. (.313) higher than it is for the days with a S.W. wind during the same period; which great difference implies that the N.E. keeps possession of the field in spite of the opposition of the S.W., and that when the S.W. preponderates, this is as a consequence of the recession of the N.E., rather than as a consequence of the S.W. overpowering the N.E.; and this would naturally be brought about by the extreme northerly latitudes of Europe partaking of that increment of temperature which is supposed now to occur in the more central districts with great energy: the northern current does not probably meet its rival face to face, but by pressing on its flank restrains it from advancing northward whilst flowing eastwardly, and then, as the northern current recedes, the eastward advances into higher latitudes. The S.W. begins to increase in frequency on April 23, and on May 10 it is established as the prevailing wind of the summer season.

AUGUST 3.	N.	N. by E.	N.N.E.	N.E. by N.	N.E.	N.E. by E.	E.N.E.	E. by N.	E.	E. by S.	E.S.E.	S.E. by E.	S.E.	S.E by S.	S.S.E.	S. by E.	S.	S. by W.	S.S.W.	S.W. by S.	S.W.	S.W. by W.	W.S.W.	W. by S.	W.	W. by N.	W.N.W.	N.W. by W.	N.W.	N.W. by N.	N.N.W.	N. by W.
	0	4	4	1	0	1	6	1	2	3	2	2	2	0	0	2	0	5	2	11	16	7	20	10	1	7	5	6	3	2	2	2

This group embraces August 1—9. August 3 is the day of max. temperature and the culminating day for the period of vaporisation. The S.W. by W. is the strong Point; N.W. by W. the Point of second strength; and S.S.E. the Point of lowest value. From the setting in of the S.W. wind on May 10 up to the present culminating period of the year the meteorological phenomena progress with considerable regularity and constancy: there is, however, some little vacillation observable in July, which seems to be attributable to the excessive accumulation of vapour: it may be supposed that active deposition occurs for a limited time on the Alps or the Appenines; this would accord with the indications observed at the site: an unusually high value is attained by the N.W. quadrant on the 10th and 11th July; during July 13—16 the increment in the atmospheric and dew-point temperatures is reduced to a merely nominal amount; on the 20th a considerable reduction in the atmospheric pressure is manifested, the values having commenced declining on the 3rd, with a simultaneous augmentation of the values for the N.W.; and on the 26th the S.E. quadrant has its lowest value for the year. The very low value for the S.S.E., and the high value for N.W. by W., exhibited by the Table under view, are explained by the above details and hypothesis. The S.W. quadrant shows its highest value for the year on August 3, and this max. value is no doubt governed by the max. temperature: the precise point from which the wind blows will be determined, first, by the position of the abundant vapour supply, and secondly, by the position of the dry and heated district to which the vapour is drawn,—the former being the English Channel, the Atlantic and the Gulf Stream; the latter, the extended inland Plains of Europe about E.N.E. of the English Channel: as the heated vapour yielding region of the Atlantic, and more especially of the Gulf Stream, shifts towards the North, the direction of the current at the site would lean more and more to the West, and this it is found to do, being at this period in the W. half of the quadrant, and approaching still nearer to the West subsequently.

SEPTEMBER 3.	N.	N. by E.	N.N.E.	N.E. by N.	N.E.	N.E. by E.	E.N.E.	E. by N.	E.	E. by S.	E.S.E.	S.E by E.	S.E.	S.E. by S.	S.S.E.	S. by E.	S.	S. by W.*	S.S.W.	S.W. by S.	S.W.	S.W. by W.	W.S.W.	W. by S.	W.	W. by N.	W.N.W.	N.W. by W.	N.W.	N.W. by N.	N.N.W.	N. by W.
	0	3	4	6	9	11	9	5	1	4	4	2	8	0	0	✓	0	0	4	4	2	2	2	4	0	8	2	2	4	4	4	3

This group embraces September 2—10. Sept. 3 is notable from the atmospheric pressure then attaining its highest value for the year. N.E. by E. is the strong Point; N.W. by W. the Point of second strength; S. by E. gives the lowest value. After the attainment of max. temperature changes of an organic and extensive kind ensue: decrement of temperature is attended with deposition, and this helps to give a new direction to the atmospheric current and produces various commotions and changes in the atmosphere. The temperature in the eastern vapour constituent—from the vapour source, and along the English Channel: the agency of next force is the low temperature of the inland districts which comes into play occasionally upon the cessation or abatement of deposition: these two agents happening to stand in opposite directions, in reference to the site, the atmospheric current is very much limited to a nearly straight line between two points. The deposition of warm vapour and the overcast sky in the inland districts, by checking the decrement of temperature,—possibly converting decrement to increment—would further tend to cause the recession or cessation of the N.E., which is exchanged for the S.W. quadrant on September 16. The decrement of temperature, although considerable at the site at this period of the year, is no doubt of greater amount in the inland neighbouring districts—North, East, and South; and the deposition would therefore be greater also, and under these circumstances there would be an efflux of atmosphere from the central point towards at least three quarters of the compass; and in accordance with this the atmospheric pressure subsides from its max. value on September 3, to its min. on October 4; and this occurs although there is not any great diminution of the vapour pressure: there remains one channel free for the *influx* of atmosphere, and this a narrow one,—*viz.*, the English Channel; it is therefore likely enough that the heavy westerly and south-westerly gales should occur here, which are in fact so commonly experienced during the season of the autumnal equinox.

	N.	N. by E.	N.N.E.	N.E. by N.	N.E.	N.E. by E.	E.N.E.	E. by N.	E.	E. by S.	E.S.E.	S.E. by E.	S.E.	S.E. by S.	S.S.E.	S. by E.	S.	S. by W.	S.S.W.	S.W. by S.	S.W.	S.W. by W.	W.S.W.	W. by S.	W.	W. by N.	W.N.W.	N.W. by W.	N.W.	N.W. by N.	N.N.W.	N. by W.
December 1.	3	3	4	3	2	4	2	1	0	^{2}	0	0	2	1	2	3	2	10	5	2	9	4	7	6	3	**14**	7	7	5	4	12	5

This group embraces November 27—December 5. W. by N. is the strong Point; E. by S. the Point of lowest value; no one Point is entitled to the second rank; and this is the only group in which the Point of lowest value stands opposite to that of the highest value: there is a range of seven Points, *viz.*, N.W. to W.S.W., which all have very high values (this is rendered more manifest if the three following more correct values be given to the three Points, N. by W., W., W. by N.; *viz.* 5, 9, 9, instead of 6, 3, 14;—see p. 10 as to cardinal Points), and in this range is accumulated a very disproportionate share of strength: the N.W. quadrant has its max. value for the year on the days Nov. 30—Dec. 2, and the W. semicircle rises very nearly to its highest value on Nov. 30. The site of governing agency appears to be extended over a greater area than is usual: the agency is supposed to be distant deposition, and the site of the controlling deposition is supposed to include the pole of minimum temperature,—the range of seven Points including several latitudes of lowest temperature.

DECEMBER 26.	N.	N. by E.	N.N.E.	N.E. by N.	N.E.	N.E. by E.	E.N.E.	E. by N.	E.	E. by S.	E.S.E.	S.E. by E.	S.E.	S.E by S.	S.S.E.	S. by E.	S.	S. by W.	S.S.W.	S.W. by S.	S.W.	S.W. by W.	W.S.W.	W. by S.	W.	W. by N.	W.N.W.	N.W. by W.	N.W.	N.W. by N.	N.N.W.	N. by W.
	2	3	8	2	5	5	5	4	0	2	6	2	3	1	✓	1	0	4	1	2	6	4	10	8	3	12	6	3	1	6	13	2

This group embraces Dec. 22—30. The strong Point is W.; the Point of second strength N.; the Point of lowest value S.S.E. Supposing the direction to be here again determined by distant and copious deposition, the site of max. deposition will then appear to be alternately in the North and in the West. The distinguishing feature of this period, consists in the sun having his extreme south declination: the arctic zone is entirely deprived of the solar rays, and the lowest temperature would probably occur in this region if there were no extensive land district in the neighbourhood; but the extended land area in the north of America causes a lower temperature to occur there, *when* radiation is active, and the site of lowest temperature consequently shifts from one of these regions to the other, according as clear sky and radiation from the earth, or cloud and radiation to the earth, preponderates.

The spot from which the atmosphere flows to another locality is not to be assumed to be exactly that indicated by the wind vane, on account of the bias given to the apparent direction by the rotation of the earth: this complication has not been noticed in the foregoing discussion because it is impossible to estimate its influence. It may be stated, generally, however, that in three quadrants, *viz.*, N.E., S.E. and S.W., the line for the direction of the locality will approximate more nearly to that from Pole to Pole than the line for the direction of wind does; and the more near the line for the locality is to that of the Poles, the greater will be the deflection of the wind: in the N.W. quadrant the rule will be reversed; a current directly from the N. Pole would arrive at southern latitudes as a N.E. wind, and the further the starting point is removed from this point the less will be the deflection.

It is to be observed that the sum of the values in these Tables never quite makes up the whole amount of 144, (9 × 16 = 144) because there were always some days on which the wind was too variable to admit of its being assigned to any one Point.

INTERTROPICAL CURRENTS.

The tropical and intertropical regions are characterised by atmospheric currents very different from those which obtain in the Temperate Zones: there are principles of action in force which are common to these two regions, but there are complications peculiar to the Torrid Zone. The revolving currents between North and South, in the Temperate Zones, depend upon the different temperature and moisture of the atmosphere in different latitudes: the rapid revolution of the surface of the earth is the agent upon which mainly depends the direction of the wind at the Equator: this influence abates with every increase of latitude; but it continues to be powerful up to the latitudes of the tropics: the surface of the earth gives to the atmosphere a motion corresponding to its own, but of course it does not communicate movement *equal* to its own; and, consequently, although the atmosphere is, in fact, circulating rapidly from W. to E., its relative and apparent movement would be from E. to W.,—if it remained uninfluenced by other causes. But it is not the great mechanical force now referred to, alone, that gives direction and force to the wind between the tropics; the peculiarities in regard to variations of temperature have great influence in some localities on the direction of the current: the small change of temperature that the sun's change of position with the seasons of the year gives rise to, causes the tendency to N. and S. currents to be very weak. Reduction of temperature produces deposition, in these regions, through three different agencies: first;—as the air and vapour ascend rapidly from the surface of the earth in consequence of the high temperature imparted to them, they arrive at a level of comparatively low temperature; and they continue to rise till the temperature is low enough to condense the vapour: secondly;—mountain ranges, from their great elevation, may have so low a temperature at their summits as to cause condensation of the atmospheric vapour; this is the case with the Himalayas: thirdly;—the polar* currents which proceed towards the Equator, and in their course impinge upon the N. and S. borders of the equatorial current, act as cooling agents upon the latter. The first of these become effective only where the sun's vertical rays produce the greatest elevation of temperature, and the greatest quantity of vapour at the level of the earth's surface; and this agency appears to be sufficient to keep up a constant profuse deposition in the varying latitude of the sun's position; so that deposition may be said, in these regions, to depend upon the excess of vapour, rather than upon low temperature: from this it results that in the neighbourhood of the tropics there is one long wet season in the year;—in India it begins in June and ceases at the end of October; but near the Equator there are two, comparatively short, wet seasons;—one whilst the sun passes from North to South, and one whilst he is passing from South to North; this, it would appear from Dr. Livingstone's statements, is very markedly the case in Africa. The Himalayas and the Ghâts are each observed to act as agents of the second class, concurring with the first; they contribute their influence in determining the periods of the wet season,—giving intensity to it, and modifying the direction of the atmospheric current: the Himalayas appear to prolong the wet season to a later date than would obtain independently of them: under their influence, the down-fall is inordinately *heavy*, also; the equatorial current towards the East is diverted towards their position, and has great velocity given to it; and it then acquires the name of the S.W. monsoon: but the increased *force* of this current occurs at an earlier date than the *wet* season; *viz.*, in May; and this may be attributable to the Plains on the North side of the Himalayas having acquired a temperature in this month superior to that which exists under the sun's vertical rays;—the heated atmosphere here ascending, and creating a current to the locality, across the Arabian and Indian Seas; and thus the heated Plain and the freezing Mountains—upon the vaporised atmosphere coming under the influence of the latter—would concur with the motion of the earth in giving velocity to the atmospheric current: the Ghâts being situated far to the South of the Himalayas, their influence is not manifested until the sun has passed far to the South: at the end of October the source of the atmospheric vapour has receded so far to the South as to be beyond the control of the Himalayas; but the Ghâts are still within the requisite distance, and at the end of October they become the focus of condensation, and the point of attraction to the atmospheric current: but, as the latitude of highest temperature moves with the sun to the South, so are the Equatorial boundaries of the polar currents transferred to the South,—the northern current encroaching upon the region of the equatorial current, and the southern receding before the equatorial current, as the latitude of highest temperature advances: and thus, the N. polar current comes within the range of the Ghâts influence, and the periodical N.E. wind is established, together with the wet season of this neighbourhood.* The third class of agents, in the reduction of temperature, appears to manifest its influence more by the disturbance it creates in the atmospheric currents, than by the condensation of vapour, in the Indian Ocean; and the southern polar current probably produces greater effects in both respects than the northern, in consequence of the influence of the latter being neutralised and superseded, by that of the land it passes over: these polar currents, —which are called, respectively, the N.E., and S.E., trade wind—as they reach the neighbourhood of the tropics, or start from them, will have but little impetus derived from the motion of the earth, and they will therefore take a strong relative westward direction: when these currents come in contact with the equatorial current where it is moving rapidly from W. to E., the collision is violent; and great disturbance of the atmospheric currents ensues. The northern tropical current is not recognised in the Indian Ocean, as the N.E. trade wind during the six months, May—October, in consequence of the influence of the land agency which gives an eastward direction to it, and a preponderating force is given to the S.W. monsoon; but during the other six months of the year the N.E. trade is present. The S.E. trade wind on the other hand having the ocean for its site continues all the year round, but changes its latitude with the season.

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* The use of the word polar is not meant to imply that the atmosphere comes from the Pole; it is used to denote a cold current proceeding from some unknown latitude between the Equator and the Pole.

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* Reduction of temperature plays an important part here, rather than excess of vapour.

In the Atlantic the line of the equatorial current is more parallel with the Equator: there is here less variety and contrast in the sea and land characteristics, and both the equatorial and the polar currents keep more to one permanent law throughout the year, than is the case at the opposite side of the globe.

TABLES.

TABLE I.

Table I. gives the mean daily temperature, in three different forms, in three separate columns. In column 1, the mean, average, diurnal value is given for each day in the year, for the sixteen years;—the correction due for diurnal range having been taken from Mr. Glaisher's Table applicable to the daily extremes of temperature.* Mr. Glaisher's monthly values, however, were reduced to their equivalents for each day, as exhibited in Appendix A. Column 2 gives the daily values as obtained by a four-fold decadal reduction[1] of the values in column 1. Column 3 gives the values as obtained by the decadal reduction repeated twenty-two times.

It was found to be necessary to repeat the decadal meaning process as often as twenty-two times, in order to produce a series of daily values which showed a line of progression consisting of two branches, that is to say, of one constantly ascending and another constantly descending branch. This extended reduction, however, was necessary only, for a very limited portion of the year;—the increment of temperature that column 2 exhibits between January 5 and January 25 constituting an irregularity in the line of progression which is not to be found in column 3. But the values in column 3 are identical (virtually) with those in column 2 on March 1 and again on October 11, and column 2 might, therefore, be adopted for the summer interval between these dates, even though column 3 were adopted for the winter interval.

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* "On the corrections to be applied to meteorological observations for diurnal range."

[1] See Page 13.

TABLE I.

ATMOSPHERIC TEMPERATURE FOR EACH DAY IN THE YEAR.

JANUARY.	Mean daily Temperature. 1	Normal Adopted daily values. 2	Continuously ascending and descending in s of progression. 3	FEBRUARY.	Mean daily Temperature. 1	Normal Adopted daily values. 2	Continuously ascending and descending lines of progression. 3	MARCH.	Mean daily Temperature. 1	Normal Adopted daily values. 2	Continuously ascending and descending lines of progression. 3
1	39°.02	39°.19	39°.81	1	38°.52	39°.52	39°.43	1	40°.49	40°.41	40°.40
2	38 .61	39 .17	39 .76	2	38 .31	39 .40	39 .42	2	40 .77	40 .44	40 .48
3	37 .31	39 .17	39 .72	3	38 .10	39 .28	39 .41	3	41 .06	40 .46	40 .58
4	39 .90	39 .16	39 .68	4	38 .20	39 .16	39 .40	4	38 .95	40 .50	40 .67
5	40 .39	39 .16	39 .65	5	39 .89	39 .05	39 .396	5	39 .93	40 .53	40 .76
6	40 .09	39 .17	39 .62	6	40 .18	38 .94	39 .393	6	38 .42	40 .58	40 .86
7	40 .18	39 .17	39 .60	7	39 .87	38 .85	39 .393	7	40 .51	40 .65	40 .96
8	38 .48	39 .18	39 .58	8	39 .66	38 .77	39 .396	8	41 .40	40 .72	41 .07
9	37 .99	39 .20	39 .56	9	38 .56	38 .71	39 .40	9	39 .89	40 .82	41 .18
10	38 .19	39 .22	39 .55	10	38 .05	38 .68	39 .41	10	41 .38	40 .92	41 .29
11	38 .59	39 .25	39 .54	11	36 .94	38 .66	39 .43	11	39 .98	41 .03	41 .41
12	38 .69	39 .28	39 .534	12	36 .23	38 .67	39 .45	12	40 .47	41 .15	41 .53
13	40 .08	39 .33	39 .530	13	36 .72	38 .71	39 .47	13	42 .06	41 .28	41 .65
14	40 .19	39 .39	39 .526	14	38 .42	38 .78	39 .50	14	41 .16	41 .41	41 .78
15	38 .18	39 .45	39 .524	15	40 .01	38 .87	39 .53	15	42 .85	41 .54	41 .91
16	39 .59	39 .52	39 .522	16	38 .70	38 .98	39 .57	16	43 .65	41 .67	42 .04
17	40 .58	39 .60	39 .521	17	39 .08	39 .11	39 .61	17	41 .74	41 .79	42 .18
18	38 .88	39 .68	39 .521	18	39 .06	39 .25	39 .65	18	41 .33	41 .92	42 .32
19	39 .78	39 .75	39 .520	19	39 .34	39 .40	39 .70	19	40 .93	42 .05	42 .47
20	39 .88	39 .82	39 .519	20	39 .12	39 .56	39 .76	20	42 .43	42 .20	42 .61
21	39 .38	39 .89	39 .517	21	38 .40	39 .71	39 .81	21	41 .83	42 .35	42 .76
22	39 .78	39 .94	39 .514	22	40 .49	39 .85	39 .87	22	42 .33	42 .51	42 .92
23	39 .77	39 .98	39 .509	23	41 .27	39 .98	39 .94	23	42 .72	42 .69	43 .07
24	41 .07	40 .00	39 .504	24	41 .15	40 .10	40 .01	24	42 .63	42 .89	43 .22
25	40 .07	40 .01	39 .498	25	41 .64	40 .19	40 .08	25	41 .32	43 .10	43 .38
26	41 .97	39 .99	39 .49	26	41 .43	40 .27	40 .16	26	42 .62	43 .33	43 .54
27	42 .06	39 .95	39 .48	27	39 .81	40 .33	40 .23	27	43 .42	43 .57	43 .70
28	40 .05	39 .89	39 .47	28	41 .20	40 .37	40 .31	28	44 .02	43 .82	43 .87
29	40 .04	39 .82	39 .46					29	42 .92	44 .07	44 .03
30	40 .34	39 .73	39 .45					30	43 .32	44 .33	44 .19
31	39 .53	39 .63	39 .44					31	45 .31	44 .57	44 .35

TABLE I.—CONTINUED.

APRIL.	Mean daily Temperature. 1	Normal Adopted daily values. 2	Continuously ascending and descending lines of progression. 3	MAY.	Mean daily Temperature. 1	Normal Adopted daily values. 2	Continuously ascending and descending lines of progression. 3	JUNE.	Mean daily Temperature. 1	Normal Adopted daily values. 2	Continuously ascending and descending lines of progression. 3
1	46°.02	44°.80	44°.52	1	49°.65	48°.83	49°.16	1	55°.04	55°.44	55°.19
2	46 .51	45 .02	44 .68	2	51 .12	48 .98	49 .33	2	55 .63	55 .59	55 .37
3	46 .42	45 .22	44 .84	3	49 .39	49 .14	49 .51	3	56 .21	55 .74	55 .54
4	46 .11	45 .40	45 .00	4	48 .97	49 .29	49 .69	4	55 .30	55 .88	55 .72
5	46 .99	45 .56	45 .16	5	49 .33	49 .46	49 .87	5	56 .49	56 .03	55 .89
6	45 .88	45 .70	45 .32	6	48 .50	49 .64	50 .06	6	56 .47	56 .18	56 .06
7	46 .86	45 .83	45 .48	7	48 .87	49 .82	50 .25	7	56 .56	56. 32	56 .22
8	46 .33	45 .94	45 .63	8	48 .84	50 .02	50 .44	8	57 .14	56 .47	56 .38
9	45 .50	46 .05	45 .79	9	49 .00	50 .24	50 .63	9	56 .83	56 .62	56 .54
10	44 .47	46 .15	45 .94	10	49 .87	50 .46	50 .83	10	56 .61	56 .76	56 .70
11	44 .64	46 .25	46 .09	11	51 .84	50 .70	51 .03	11	56 .80	56 .91	56 .86
12	45 .61	46 .36	46 .24	12	50 .91	50 .95	51 .23	12	56 .58	57 .05	57 .01
13	46 .08	46 .47	46 .39	13	51 .58	51 .21	51 .43	13	56 .86	57 .20	57 .16
14	45 .95	46 .58	46 .54	14	51 .05	51 .47	51 .64	14	58 .24	57 .35	57 .31
15	47 .72	46 .70	46 .68	15	52 .02	51 .74	51 .84	15	57 .31	57 .50	57 .46
16	47 .29	46 .82	46 .83	16	52 .49	52 .02	52 .05	16	57 .59	57 .66	57 .60
17	48 .36	46 .94	46 .98	17	53 .15	52 .30	52 .25	17	57 .37	57 .82	57 .74
18	47 .53	47 .07	47 .12	18	52 .63	52 .57	52 .46	18	57 .14	57 .99	57 .88
19	46 .91	47 .20	47 .27	19	52 .19	52 .84	52 .66	19	58 .62	58 .16	58 .02
20	47 .29	47 .33	47 .42	20	52 .47	53 .10	52 .87	20	57 .39	58 .33	58 .15
21	47 .57	47 .46	47 .57	21	52 .55	53 .36	53 .07	21	58 .07	58 .51	58 .28
22	47 .85	47 .59	47 .72	22	52 .92	53 .60	53 .27	22	58 .65	58 .68	58 .41
23	46 .53	47 .72	47 .87	23	54 .70	53 .83	53 .47	23	59 .02	58 .84	58 .53
24	47 .81	47 .86	48 .02	24	54 .58	54 .06	53 .68	24	60 .40	59 .00	58 .65
25	47 .39	47 .99	48 .18	25	55 .25	54 .26	53 .87	25	59 .28	59 .15	58 .77
26	48 .46	48 .13	48 .33	26	56 .04	54 .46	54 .07	26	60 .57	59 .28	58 .88
27	48 .24	48 .26	48 .49	27	56 .02	54 .64	54 .26	27	59 .96	59 .41	58 .99
28	47 .81	48 .40	48 .65	28	56 .00	54 .82	54 .45	28	59 .54	59 .52	59 .09
29	47 .39	48 .54	48 .82	29	54 .38	54 .98	54 .64	29	60 .33	59 .62	59 .19
30	49 .26	48 .69	48 .98	30	53 .97	55 .14	54 .83	30	59 .42	59 .71	59 .29
				31	53 .65	55 .29	55 .01				

TABLE I.—CONTINUED.

OCTOBER.	Mean daily Temperature. 1	Normal Adopted daily values. 2	Continuously ascending and descending lines of progression. 3	NOVEMBER.	Mean daily Temperature. 1	Normal Adopted daily values. 2	Continuously ascending and descending lines of progression. 3	DECEMBER.	Mean daily Temperature. 1	Normal Adopted daily values. 2	Continuously ascending and descending lines of progression. 3
1	54°.86	54°.36	54°.12	1	49°.06	47°.26	47°.22	1	41°.05	42°.11	42°.53
2	53 .76	54 .15	53 .90	2	47 .67	47 .10	47 .02	2	40 .75	42 .08	42 .42
3	55 .05	53 .94	53 .67	3	47 .88	46 .94	46 .82	3	41 .06	42 .07	42 .33
4	54 .85	53 .72	53 .44	4	45 .79	46 .77	46 .63	4	41 .27	42 .07	42 .23
5	53 .34	53 .48	53 .22	5	45 .80	46 .58	46 .44	5	44 .58	42 .08	42 .13
6	53 .14	53 .24	52 .98	6	46 .11	46 .38	46 .25	6	43 .09	42 .10	42 .03
7	54 .13	52 .98	52 .75	7	46 .72	46 .17	46 .06	7	43 .00	42 .11	41 .94
8	53 .63	52 .71	52 .52	8	48 .34	45 .94	45 .87	8	42 .00	42 .12	41 .84
9	51 .62	52 .43	52 .28	9	45 .16	45 .70	45 .69	9	42 .01	42 .12	41 .71
10	52 .02	52 .14	52 .05	10	46 .18	45 .46	45 .51	10	43 .32	42 .10	41 .66
11	53 .21	51 .84	51 .81	11	45 .80	45 .22	45 .33	11	41 .33	42 .06	41 .56
12	51 .12	51 .55	51 .58	12	45 .32	44 .98	45 .15	12	40 .63	42 .00	41 .47
13	50 .11	51 .25	51 .35	13	44 .14	44 .74	44 .98	13	41 .05	41 .91	41 .37
14	50 .51	50 .95	51 .11	14	43 .96	44 .52	44 .81	14	42 .96	41 .79	41 .28
15	51 .11	50 .66	50 .88	15	42 .58	44 .30	44 .64	15	43 .67	41 .66	41 .18
16	49 .51	50 .38	50 .65	16	44 .00	44 .09	44 .48	16	44 .39	41 .49	41 .09
17	49 .82	50 .11	50 .42	17	40 .51	43 .90	44 .32	17	42 .70	41 .31	40 .99
18	50 .23	49 .84	50 .19	18	42 .82	43 .71	44 .17	18	41 .10	41 .11	40 .90
19	49 .34	49 .59	49 .97	19	44 .14	43 .54	44 .01	19	40 .39	40 .89	40 .80
20	48 .45	49 .35	49 .74	20	44 .15	43 .38	43 .87	20	41 .19	40 .67	40 .71
21	48 .65	49 .12	49 .52	21	45 .26	43 .22	43 .73	21	40 .18	40 .46	40 .62
22	48 .36	48 .90	49 .30	22	44 .88	43 .06	43 .59	22	38 .28	40 .25	40 .53
23	51 .17	48 .70	49 .08	23	42 .79	42 .91	43 .45	23	39 .87	40 .05	40 .44
24	48 .58	48 .50	48 .87	24	43 .09	42 .77	43 .33	24	37 .96	39 .87	40 .35
25	48 .89	48 .32	48 .65	25	43 .10	42 .63	43 .20	25	39 .26	39 .71	40 .27
26	46 .90	48 .15	48 .44	26	40 .81	42 .51	43 .08	26	39 .35	39 .57	40 .19
27	45 .11	47 .99	48 .23	27	41 .62	42 .39	42 .96	27	39 .35	39 .46	40 .12
28	47 .92	47 .83	48 .03	28	41 .72	42 .30	42 .85	28	38 .14	39 .37	40 .05
29	46 .23	47 .69	47 .82	29	41 .83	42 .21	42 .74	29	37 .84	39 .30	39 .98
30	47 .04	47 .55	47 .62	30	41 .14	42 .15	42 .63	30	40 .53	39 .25	39 .92
31	49 .15	47 .40	47 .42					31	40 .32	39 .21	39 .86

TABLE I.—CONTINUED.

JULY.	Mean daily Temperature.	Normal Adopted daily values.	Continuously ascending and descending lines of progression.	AUGUST.	Mean daily Temperature.	Normal Adopted daily values.	Continuously ascending and descending lines of progression.	SEPTEMBER.	Mean daily Temperature.	Normal Adopted daily values.	Continuously ascending and descending lines of progression.
	1	2	3		1	2	3		1	2	3
1	59°.00	59°.79	59°.39	1	61°.60	61°.33	60°.906	1	59°.48	59°.40	59°.19
2	59 .69	59 .87	59 .47	2	61 .63	61 .35	60 .911	2	60 .04	59 .26	59 .07
3	59 .97	59 .94	59 .56	3	62 .25	61 .37	60 .913	3	58 .59	59 .12	58 .95
4	59 .77	60 .00	59 .64	4	61 .48	61 .37	60 .911	4	58 .64	58 .98	58 .83
5	60 .08	60 .05	59 .72	5	61 .91	61 .35	60 .905	5	57 .79	58 .84	58 .71
6	60 .48	60 .11	59 .80	6	61 .33	61 .33	60 .894	6	58 .92	58 .71	58 .58
7	60 .79	60 .15	59 .88	7	60 .96	61 .30	60 .88	7	56 .96	58. 59	58 .44
8	60 .99	60 .20	59 .95	8	61 .68	61 .27	60 .86	8	57 .70	58 .48	58 .31
9	59 .60	60 .24	60 .01	9	60 .61	61 .22	60 .84	9	57 .84	58 .38	58 .17
10	59 .41	60 .27	60 .08	10	60 .83	61 .18	60 .81	10	58 .68	58 .28	58 .03
11	59 .81	60 .30	60 .14	11	60 .86	61 .13	60 .78	11	59 .03	58 .17	57 .88
12	60 .82	60 .33	60 .20	12	61 .48	61 .07	60 .74	12	58 .16	58 .07	57 .73
13	61 .13	60 .35	60 .26	13	61 .91	61 .01	60 .70	13	58 .47	57 .96	57 .57
14	60 .85	60 .37	60 .31	14	60 .73	60 .95	60 .66	14	57 .79	57 .83	57 .41
15	61 .46	60 .39	60 .36	15	60 .86	60 .89	60 .61	15	57 .40	57 .70	57 .25
16	60 .68	60 .41	60 .41	16	60 .58	60 .82	60 .55	16	59 .61	57 .54	57 .08
17	60 .10	60 .44	60 .46	17	60 .71	60 .75	60 .50	17	59 .52	57 .37	56 .91
18	60 .32	60 .47	60 .51	18	61 .04	60 .69	60 .44	18	56 .83	57 .18	56 .74
19	58 .94	60 .50	60 .55	19	60 .67	60 .62	60 .37	19	56 .53	56 .98	56 .56
20	59 .36	60 .55	60 .59	20	61 .91	60 .55	60 .30	20	56 .53	56 .77	56 .38
21	60 .49	60 .60	60 .63	21	60 .66	60 .48	60 .23	21	56 .03	56 .54	56 .19
22	60 .61	60 .66	60 .67	22	60 .20	60 .41	60 .15	22	56 .23	56 .31	56 .00
23	60 .64	60 .73	60 .71	23	59 .04	60 .34	60 .07	23	57 .12	56 .08	55 .81
24	60 .76	60 .80	60 .74	24	58 .49	60 .26	59 .99	24	56 .82	55 .85	55 .61
25	60 .79	60 .88	60 .77	25	58 .53	60 .19	59 .90	25	55 .21	55 .62	55 .40
26	61 .01	60 .97	60 .80	26	60 .78	60 .10	59 .81	26	54 .40	55 .39	55 .20
27	61 .64	61 .04	60 .83	27	61 .53	60 .01	59 .71	27	53 .19	55 .18	54 .99
28	61 .37	61 .12	60 .85	28	61 .78	59 .90	59 .62	28	54 .59	54 .97	54 .78
29	61 .40	61 .19	60 .87	29	61 .52	59 .79	59 .51	29	54 .28	54 .77	54 .56
30	61 .73	61 .25	60 .89	30	59 .88	59 .67	59 .41	30	55 .07	54 .56	54 .35
31	61 .07	61. 30	60 .90	31	59 .03	59 .53	59 .30				

TABLE II.

ATMOSPHERIC TEMPERATURE FOR EACH DIVISION OF THE YEAR.

The particulars given in this Table are collected from column 2—or column of normal daily values—in Table I.

Note.—When the last decimal in this and the following Tables is marked thus $\ddot{5}$, it implies that the 5 is above the actual value:—when marked thus $\underset{..}{5}$, it implies that it is below the actual value.

MEAN TEMPERATURE FOR THE YEAR				49°.38.
Winter. . . .	39°.99	*Meteorological*	Winter[1]	39°.81
Spring	46 .92		Spring.	49 .56
Summer . . .	59 .63		Summer.	59 .99
Autumn . . .	50 .78		Autumn.	48 .13
January . . .	39 .54		Section I. . . . (*coldest.*)	39 .30
February . .	39 .33		Section II.	41 .04
March	41 .91		Section III.	45 .23
April.	46 .80		Section IV. . . . (*mean.*)	49 .47
May.	52 .04		Section V.	55 .64
June	57 .62		Section VI.	59 .78
July.	60 .49		Section VII. . . (*hottest.*)	61 .0$\ddot{5}$
August. . . .	60 .72		Section VIII.	59 .40
September. .	57 .29		Section IX.	55 .73
October . . .	50 .61		Section X. . . . . (*mean.*)	49 .3$\underset{..}{5}$
November. .	44 .43		Section XI.	43 .21
December. .	41 .04		Section XII.	39 .72

Mean temperature occurs on May 5 and October 20.
Mean daily rise of temperature—from February 11 to August 3—0°.13.
Mean daily fall of temperature—from August 3 to February 11—0°.12.
There are 170 days above the mean, and 195 below the mean.

The pole[2] of low temperature,—*i.e.*, the date of the min. value in column 3 of Table I.—falls on February 6 and 7.

The pole of high temperature,—*i.e.*, the date of the max. value in column 3 of Table I.—falls on August 3 and 4.

Minimum temperature,—*i.e.*, the lowest value in column 2 of Table I.—is 38°.66, which occurs on February 11.

Maximum temperature,—*i.e.*, the highest value in column 2 of Table I.—is 61°.37, which occurs on August 3.

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[1] See page 17 for the divisions of the year.

[2] See page 15.

TABLE III.

ATMOSPHERIC TEMPERATURE FOR EVERY MONTH IN THE SIXTEEN YEARS.

In the computation of this Table each day's maximum and minimum was corrected for index error, whilst in the computation of Table I.—and consequently of Table II.—this correction was applied to the mean daily values of the 16 years. The values in this Table are not affected by the decadal meaning: but are reduced to their equivalents for the diurnal means.

	JAN.	FEB.	MARCH.	APRIL.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	SUMS.	MEANS.
1841	35°.9	35°.6	45°.4	47°.8	55°.6	55°.8	58°.4	60°.3	58°.5	50°.7	44°.2	42°.3	590°.5	49°.2
1842	34 .5	41 .1	44 .3	46 .0	52 .7	61 .5	58 .7	63 .5	57 .6	44 .8	44 .6	44 .9	594 .2	49 .5
1843	40 .1	36 .6	42 .2	47 .1	51 .3	55 .4	60 .0	60 .8	59 .7	49 .6	44 .1	45 .4	592 .3	49 .4
1844	40 .2	36 .3	41 .9	49 .3	51 .3	57 .6	60 .0	58 .0	57 .9	50 .6	44 .8	35 .1	583 .0	48 .6
1845	39 .5	34 .0	35 .7	46 .7	50 .3	59 .0	58 .9	58 .1	55 .4	50 .4	46 .8	42 .2	577 .0	48 .1
1846	44 .4	44 .1	44 .5	48 .1	54 .4	63 .7	62 .6	63 .8	60 .4	51 .7	46 .2	33 .1	617 .0	51 .4
1847	38 .1	36 .7	41 .6	45 .0	54 .4	57 .4	62 .7	61 .6	54 .6	53 .5	47 .0	42 .1	594 .7	49 .6
1848	36 .0	43 .6	44 .0	48 .2	55 .0	57 .9	59 .5	58 .7	55 .8	51 .2	42 .5	43 .8	596 .2	49 .7
1849	41 .7	43 .0	43 .0	44 .7	54 .0	57 .2	59 .5	61 .2	57 .5	51 .4	45 .3	38 .9	597 .4	49 .8
1850	34 .7	44 .5	39 .0	49 .6	51 .0	57 .6	60 .4	59 .1	56 .0	46 .3	47 .0	42 .0	587 .2	48 .9
1851	44 .1	40 .6	44 .0	45 .1	51 .3	57 .9	59 .7	61 .5	56 .5	53 .1	37 .7	40 .6	592 .1	49 .3
1852	42 .2	41 .6	40 .6	44 .2	50 .9	56 .2	64 .2	61 .3	57 .5	48 .2	50 .0	48 .5	605 .4	50 .5
1853	43 .1	34 .4	38 .3	47 .7	51 .9	56 .5	59 .8	59 .0	56 .0	51 .5	42 .7	36 .3	577 .2	48 .1
1854	40 .6	40 .9	43 .3	47 .9	50 .7	56 .5	60 .0	60 .2	58 .2	50 .5	41 .8	42 .9	593 .5	49 .5
1855	37 .0	31 .9	39 .1	46 .3	48 .7	55 .9	61 .1	60 .9	57 .3	52 .9	42 .7	38 .6	572 .4	47 .7
1856	41 .3	43 .0	40 .9	46 .7	49 .9	56 .8	60 .0	62 .8	55 .5	53 .2	41 .6	41 .6	593 .3	49 .4
SUMS.	633 .4	627 .9	667 .8	750 .4	833 .4	922 .9	965 .5	970 .8	914 .4	809 .6	709 .0	658 .3	9463 .4	
MEANS.	39 .6	39 .2	41 .7	46 .9	52 .1	57 .7	60 .3	60 .7	57 .2	50 .6	44 .3	41 .1		49 .3

TABLE IV.

MEANS OF THE MAXIMA OF THE MINIMA AND OF THE DAILY RANGE OF ATMOSPHERIC TEMPERATURE FOR EACH MONTH.

The daily values from which the particulars in this Table were computed had not been subjected to the decadal meaning process. The daily range was computed from sixty (not thirty) terms for the month;—each interval from maximum to minimum, as well as from minimum to maximum, being taken into account.

	Means of the Maxima.	Means of the Minima.	Means of Daily Ranges.
The Year.	57°.9	42°.6	15°.3
January.	44.0	35.5	8.5
February	44.8	34.3	10.5
March	49.8	34.9	14.9
April.	57.3	38.8	18.5
May	63.7	43.8	19.9
June	69.8	49.5	20.3
July	71.9	52.5	19.4
August.	72.8	52.8	19.6
September . . .	67.3	48.8	18.5
October	58.2	44.6	13.6
November . . .	50.1	39.4	10.7
December. . . .	45.5	36.7	8.8

In each year the temperature rose as high as to 79°.
In each year the temperature fell as low as to 21°.8.

The highest temperature that occurred in the sixteen years was 90°.4,—on August 3, 1856.

The lowest temperature that occurred in the sixteen years was 12°.8,—on February 12, 1847.

The highest mean temperature of any group of 10 consecutive days, during the sixteen years, was 70°.

The lowest mean temperature of any group of 10 consecutive days, during the sixteen years, was 26°.2.

The greatest range between any minimum and proximate maximum that occurred during the sixteen years was 39°.8,—on March 24, 1852.

TABLE V.

TEMPERATURE AS INDICATED BY TERMOMETER HEATED BY THE SUN FOR EACH DIVISION OF THE YEAR.[1]

The values in this Table are the means for the eight years 1845—'52, reduced by a two-fold decadal reduction. The maximum temperature registered by the thermometer each day was the particular recorded.

MEAN VALUE FOR THE YEAR 68°.46.				
Winter....	52°.6	*Meteorological*	Winter	53°.0
Spring	67 .4		Spring...........	71 .3
Summer ...	82 .6		Summer..........	72 .5
Autumn ...	70 .5		Autumn..........	65 .5
January ...	49 .9		Section I. .... *(coldest.)*	54 .9
February ..	56 .1		Section II.........	57 .7
March	59 .3		Section III.	64 .7
April.....	66 .8		Section IV. .... *(mean.)*	71 .6
May......	76 .0		Section V.........	79 .7
June	80 .7		Section VI.	83 .3
July......	83 .7		Section VII. .. *(hottest.)*	82 .9
August....	83 .2		Section VIII.......	84 .8
September. .	81 .7		Section IX.	77 .5
October ...	69 .9		Section X. ..... *(mean.)*	68 .5
November. .	60 .0		Section XI.	57 .2
December. .	52 .2		Section XII.	49 .9

The max. value for the year is 86°.8, which falls on September 3.
The min. value for the year is 48°.9, which falls on January 11.
The highest value recorded on any one day is 108°, in July.
The lowest value recorded on any one day is 26°, in January.

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[1] For description of the thermometer see page 3.

TABLE VI.

DEW-POINT TEMPERATURE FOR EACH DAY IN THE YEAR.

The first of the two columns for each month in this Table gives the mean daily values as belonging to the sixteen years, corrected for diurnal variation by the Table for the purpose given in the Appendix. The second of the two columns gives the values of the first column reduced by a four-fold decadal reduction.

Note.—In this Table the ultimate 5 in the line of "Means" is marked according as it is above or below the real value, but this is not done in the daily values of this Table, nor in those of Table I.

TABLE VI.

	JANUARY.		FEBRUARY.		MARCH.		APRIL.	
	1	**2**	**1**	**2**	**1**	**2**	**1**	**2**
1	34°.03	35°.42	32°.95	34°.69	33°.68	34°.51	39°.37	37°.47
2	34 .49	35 .41	35 .35	34 .59	35 .71	34 .49	39 .48	37 .66
3	33 .14	35 .41	33 .85	34 .48	34 .14	34 .48	38 .69	37 .82
4	38 .58	35 .41	33 .45	34 .38	32 .68	34 .47	39 .50	37 .95
5	36 .52	35 .41	36 .94	34 .28	34 .81	34 .48	38 .81	38 .05
6	36 .70	35 .40	33 .94	34 .18	31 .84	34 .49	39 .12	38 .13
7	37 .40	35 .40	35 .44	34 .09	35 .07	34 .53	38 .53	38 .18
8	35 .60	35 .39	35 .24	34 .00	34 .80	34 .57	39 .54	38 .21
9	32 .00	35 .38	33 .54	33 .92	33 .56	34 .63	36 .45	38 .23
10	34 .20	35 .39	32 .04	33 .86	34 .56	34 .69	36 .36	38 .24
11	35 .00	35 .40	31 .73	33 .80	35 .26	34 .76	36 .37	38 .25
12	33 .80	35 .43	32 .33	33 .77	35 .27	34 .83	38 .18	38 .27
13	36 .80	35 .45	32 .43	33 .76	33 .87	34 .89	39 .59	38 .29
14	34 .00	35 .48	35 .32	33 .77	34 .98	34 .96	38 .20	38 .32
15	34 .20	35 .52	36 .22	33 .80	36 .78	35 .02	37 .91	38 .36
16	37 .20	35 .56	32 .01	33 .84	37 .79	35 .08	38 .52	38 .42
17	37 .09	35 .59	33 .31	33 .90	35 .29	35 .13	38 .73	38 .49
18	35 .19	35 .62	32 .00	33 .98	33 .60	35 .18	39 .53	38 .56
19	37 .28	35 .64	33 .89	34 .07	35 .10	35 .23	37 .04	38 .65
20	36 .98	35 .63	33 .58	34 .16	35 .11	35 .30	38 .24	38 .74
21	35 .17	35 .62	32 .77	34 .25	34 .51	35 .38	38 .14	38 .85
22	35 .07	35 .59	36 .55	34 .33	35 .82	35 .48	40 .15	38 .96
23	35 .27	35 .54	35 .43	34 .40	35 .62	35 .60	38 .85	39 .07
24	36 .66	35 .48	35 .20	34 .45	34 .03	35 .75	39 .16	39 .20
25	34 .66	35 .40	36 .87	34 .49	34 .53	35 .92	40 .06	39 .32
26	37 .66	35 .31	36 .36	34 .51	33 .74	36 .12	39 .58	39 .46
27	35 .15	35 .22	33 .51	34 .52	36 .15	36 .33	38 .28	39 .61
28	35 .05	35 .12	34 .35	34 .52	36 .87	36 .56	38 .60	39 .77
29	33 .75	35 .01			34 .29	36 .80	40 .00	39 .94
30	34 .25	34 .90			37 .12	37 .04	40 .00	40 .12
31	35 .45	34 .80			39 .45	37 .27		
SUMS.	1098 .34	1097 .33	956 .60	956 .79	1086 .03	1093 .97	1160 .98	1158 .59
MEANS.	35 .43	35 .40	34 .16	34 .17	35 .03	35 .29	38 .70	38 .62

TABLE VI—CONTINUED.

	MAY.		JUNE.		JULY.		AUGUST.	
	1	**2**	**1**	**2**	**1**	**2**	**1**	**2**
1	41°.80	40°.31	47°.28	47°.23	50°.14	51°.90	53°.52	53°.73
2	40 .10	40 .51	47 .86	47 .32	50 .97	52 .03	53 .89	53 .73
3	39 .60	40 .72	46 .85	47 .42	51 .89	52 .15	55 .26	53 .73
4	40 .00	40 .95	45 .84	47 .52	53 .61	52 .26	53 .32	53 .71
5	40 .80	41 .19	47 .43	47 .63	53 .23	52 .38	54 .09	53 .69
6	42 .40	41 .44	48 .12	47 .76	52 .86	52 .48	52 .55	53 .67
7	42 .20	41 .69	47 .91	47 .90	53 .28	52 .58	53 .40	53 .63
8	40 .90	41 .95	48 .60	48 .04	52 .40	52 .67	55 .26	53 .59
9	40 .30	42 .22	47 .89	48 .20	52 .52	52 .76	53 .31	53 .54
10	43 .50	42 .49	48 .48	48 .36	52 .24	52 .85	52 .87	53 .48
11	42 .90	42 .76	46 .77	48 .53	52 .66	52 .93	52 .83	53 .41
12	43 .90	43 .04	47 .56	48 .70	52 .98	53 .00	54 .49	53 .34
13	44 .90	43 .32	50 .95	48 .88	54 .00	53 .06	54 .65	53 .26
14	43 .30	43 .60	49 .44	49 .06	54 .22	53 .12	53 .21	53 .17
15	42 .30	43 .88	50 .13	49 .24	53 .34	53 .17	52 .47	53 .07
16	44 .80	44 .16	49 .42	49 .43	52 .73	53 .22	51 .94	52 .97
17	45 .30	44 .44	48 .93	49 .61	53 .52	53 .27	54 .31	52 .87
18	44 .40	44 .72	49 .74	49 .79	52 .81	53 .32	52 .48	52 .77
19	43 .70	44 .99	49 .95	49 .98	53 .09	53 .36	52 .55	52 .67
20	43 .10	45 .25	49 .77	50 .16	52 .97	53 .40	53 .63	52 .58
21	45 .90	45 .51	50 .28	50 .34	53 .45	53 .44	52 .11	52 .48
22	46 .80	45 .75	49 .79	50 .52	54 .34	53 .48	51 .79	52 .38
23	46 .50	45 .98	49 .61	50 .69	53 .02	53 .52	50 .57	52 .28
24	47 .70	46 .19	51 .62	50 .86	53 .60	53 .56	51 .95	52 .19
25	47 .30	46 .38	51 .83	51 .03	53 .78	53 .59	50 .83	52 .09
26	47 .80	46 .54	51 .64	51 .19	53 .36	53 .62	52 .91	51 .99
27	47 .70	46 .69	52 .95	51 .35	54 .24	53 .66	53 .19	51 .88
28	48 .40	46 .82	52 .87	51 .50	54 .52	53 .68	53 .17	51 .77
29	46 .80	46 .94	51 .18	51 .64	53 .20	53 .70	52 .65	51 .64
30	45 .10	47 .04	51 .40	51 .77	52 .98	53 .71	50 .83	51 .51
31	46 .80	47 .14			54 .05	53 .73	51 .41	51 .38
SUMS.	1367 .00	1364 .61	1482 .09	1481 .65	1646 .00	1645 .60	1641 .44	1638 .20
MEANS.	44 .10	44 .02	49 .40	49 .39	53 .10	53 .09	52 .95¨	52 .85¨

TABLE VI—CONTINUED.

	SEPTEMBER.		OCTOBER.		NOVEMBER.		DECEMBER.	
	1	2	1	2	1	2	1	2
1	52°.02	51°.26	48°.81	48°.49	42°.41	42°.88	37°.80	38°.55
2	51 .92	51 .13	48 .02	48 .38	44 .65	42 .74	37 .51	38 .53
3	50 .82	51 .01	50 .73	48 .25	41 .90	42 .59	37 .92	38 .52
4	50 .63	50 .90	49 .74	48 .10	41 .36	42 .43	38 .03	38 .52
5	49 .43	50 .80	48 .65	47 .92	41 .43	42 .25	42 .44	38 .51
6	49 .03	50 .72	48 .46	47 .73	42 .21	42 .06	39 .55	38 .51
7	48 .43	50 .65	48 .37	47 .51	42 .90	41 .86	39 .16	38 .49
8	49 .54	50 .60	46 .58	47 .27	44 .00	41 .65	38 .67	38 .47
9	50 .44	50 .56	47 .79	47 .01	40 .30	41 .42	38 .48	38 .42
10	52 .74	50 .52	46 .90	46 .74	40 .88	41 .20	38 .89	38 .36
11	49 .54	50 .49	47 .50	46 .47	41 .95	40 .98	36 .50	38 .28
12	51 .65	50 .46	46 .00	46 .19	42 .61	40 .77	37 .51	38 .18
13	50 .26	50 .42	43 .90	45 .92	39 .56	40 .56	37 .13	38 .05
14	50 .27	50 .37	45 .20	45 .66	38 .49	40 .37	38 .55	37 .90
15	51 .48	50 .31	44 .70	45 .42	39 .10	40 .18	40 .17	37 .73
16	51 .69	50 .23	44 .01	45 .18	40 .00	40 .01	40 .09	37 .53
17	52 .20	50 .14	45 .51	44 .97	36 .10	39 .86	38 .71	37 .33
18	50 .21	50 .03	43 .31	44 .77	38 .60	39 .72	37 .93	37 .11
19	48 .62	49 .90	44 .01	44 .58	39 .90	39 .59	37 .25	36 .89
20	49 .34	49 .77	44 .01	44 .41	41 .70	39 .46	36 .67	36 .67
21	48 .95	49 .63	44 .21	44 .25	40 .80	39 .34	33 .89	36 .45
22	49 .16	49 .49	45 .42	44 .11	40 .40	39 .23	33 .31	36 .24
23	50 .77	49 .35	47 .22	43 .97	39 .10	39 .12	35 .23	36 .06
24	49 .98	49 .22	43 .82	43 .84	39 .90	39 .02	35 .65	35 .90
25	48 .88	49 .10	42 .93	43 .72	37 .50	38 .92	36 .47	35 .76
26	46 .89	48 .98	41 .93	43 .60	39 .80	38 .83	36 .27	35 .65
27	47 .49	48 .88	41 .04	43 .48	37 .90	38 .75	34 .67	35 .56
28	47 .80	48 .78	43 .34	43 .36	38 .60	38 .68	32 .17	35 .50
29	48 .40	48 .69	40 .65	43 .25	36 .80	38 .63	34 .07	35 .46
30	48 .81	48 .59	45 .06	43 .13	36 .90	38 .58	39 .16	35 .44
31			46 .58	43 .01			35 .95	35 .43
SUMS.	1497 .39	1500 .98	1414 .40	1410 .69	1207 .75	1211 .68	1155 .80	1154 .00
MEANS.	49 .91	50 .03	45 .63	45 .51	40 .26	40 .39	37 .28	37 .16

TABLE VII.

DEW POINT TEMPERATURE FOR EACH DIVISION OF THE YEAR.

The values in this Table were computed from daily values which had been reduced by a four-fold decadal reduction :—see Table VI. The mean daily values were corrected for diurnal range by means of a modification of Mr. Glaisher's Table for this purpose prior to the reduction: the Table of corrections used, as applicable to Newport, together with an explanation, will be found in the Appendix.

MEAN DEW-POINT FOR THE YEAR 43°.05.

Winter. . . .	35°.65	*Meteorological*	Winter	35°.06
Spring	39 .32		Spring.	41 .60
Summer . . .	51 .82		Summer.	52 .25
Autumn . . .	45 .31		Autumn.	43 .34
January . . .	35 .40		Section I. . . . *(coldest.)*	34 .34
February . .	34 .17		Section II.	34 .78
March	35 .29		Section III.	37 .57
April.	38 .62		Section IV. . . . *(mean.)*	41 .17
May.	44 .02		Section V.	47 .48
June	49 .39		Section VI.	52 .09
July.	53 .09		Section VII. . . *(hottest.)*	53 .46
August. . . .	52 .85		Section VIII.	51 .39
September. .	50 .03		Section IX.	49 .20
October . . .	45 .51		Section X. . . . . *(mean.)*	44 .49
November. .	40 .39		Section XI.	39 .35
December . .	37 .16		Section XII.	35 .76

Mean dew-point temperature occurs on May 12 and October 31.
Mean daily rise of dew-point,—from February 13 to August 1,—0°.12.
Mean daily fall of dew-point,—from August 1 to February 13,—0°.10.
There are 172 days above the mean, and 193 below the mean.
Lowest dew-point is 33°.76, which occurs on February 13.
Highest dew-point is 53°.73, which occurs on August 1 and 2.

The highest dew-point that occurred in the 16 years was 69°, on August 7, 1846.
The lowest dew-point that occurred in the 16 years was 9°, on February 17, 1855.

TABLE VIII.

DEW-POINT TEMPERATURE FOR EVERY MONTH IN THE SIXTEEN YEARS.

This Table is not affected by the decadal meaning. The readings are reduced to mean diurnal values by the Table of monthly corrections given in the Appendix.

	JAN.	FEB.	MARCH.	APRIL.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	SUMS.	MEANS.
1841	32°.5	30°.9	40°.3	38°.8	48°.6	46°.4	50°.6	53°.1	53°.0	45°.1	40°.5	38°.6	518°.4	43°.2
1842	29 .8	38 .5	37 .8	35 .1	44 .3	49 .9	50 .2	55 .5	50 .1	39 .9	40 .9	43 .0	515 .0	42 .9
1843	37 .4	32 .5	36 .9	40 .6	45 .7	48 .5	52 .2	54 .0	52 .4	44 .5	41 .1	42 .0	527 .8	44 .0
1844	35 .9	32 .4	35 .8	42 .4	41 .9	48 .9	51 .6	48 .9	51 .3	45 .3	41 .5	31 .0	506 .9	42 .2
1845	36 .1	29 .4	29 .0	39 .4	43 .0	51 .2	53 .1	50 .1	47 .3	45 .6	43 .2	37 .7	505 .1	42 .1
1846	41 .7	39 .7	38 .3	40 .7	44 .8	54 .0	55 .2	56 .0	53 .6	47 .1	41 .8	30 .0	542 .9	45 .2
1847	34 .4	32 .1	34 .3	37 .4	54 .3	48 .3	54 .6	52 .1	45 .3	48 .5	44 .0	38 .9	524 .2	43 .7
1848	31 .2	39 .4	38 .5	41 .3	46 .4	51 .1	53 .7	52 .5	50 .4	46 .7	38 .7	39 .4	529 .3	44 .1
1849	37 .5	38 .7	36 .5	37 .9	46 .6	48 .4	51 .0	52 .5	50 .2	46 .2	41 .6	34 .7	521 .8	43 .5
1850	30 .3	39 .4	31 .6	42 .1	43 .1	50 .1	54 .6	51 .0	47 .9	40 .6	43 .1	38 .5	512 .3	42 .7
1851	40 .1	35 .9	37 .7	38 .4	42 .4	50 .4	52 .0	52 .8	47 .8	48 .2	33 .1	37 .4	516 .2	43 .0
1852	38 .0	34 .3	32 .5	34 .0	42 .3	50 .6	58 .1	55 .1	50 .8	43 .0	45 .9	44 .4	529 .0	44 .1
1853	38 .3	27 .8	31 .2	38 .9	43 .3	49 .9	53 .7	52 .0	49 .4	47 .6	38 .8	31 .3	502 .2	41 .9
1854	36 .7	34 .0	36 .4	36 .9	43 .5	47 .5	51 .7	52 .1	50 .0	45 .2	36 .2	37 .3	507 .5	42 .3
1855	31 .0	24 .7	32 .7	35 .7	39 .1	47 .6	54 .7	53 .7	50 .4	47 .8	37 .3	34 .2	488 .9	40 .7
1856	36 .6	37 .4	32 .2	39 .8	42 .5	48 .1	52 .7	55 .4	48 .0	48 .8	37 .1	37 .4	516 .0	43 .0
SUMS.	567 .5	547 .1	561 .7	619 .4	711 .8	790 .9	849 .7	846 .8	797 .9	730 .1	644 .8	595 .8	8263 .5	
MEANS.	35 .5	34 .2	35 .1	38 .7	44 .5	49 .4	53 .1	52 .9	49 .9	45 .6	40 .3	37 .2		43 .0

TABLE IX.

DIFFERENCE BETWEEN ATMOSPHERIC AND DEW POINT TEMPERATURE FOR EACH DIVISION OF THE YEAR.

The particulars given in this Table were computed from the daily differences between the mean daily values from which Tables II. and VII. were computed.

MEAN DIFFERENCE FOR THE YEAR				6°.32
Winter. . . .	4°.34	*Meteorological*	Winter	4°.75
Spring	7 .60		Spring.	7 .96
Summer . . .	7 .83		Summer.	7 .75
Autumn . . .	5 .46		Autumn.	4 .79
January . . .	4 .14		Section I. . . . *(coldest.)*	4 .96
February . .	5 .16		Section II.	6 .26
March	6 .62		Section III.	7 .66
April	8 .18		Section IV. . . . *(mean.)*	8 .30
May.	8 .02		Section V.	8 .16
June	8 .24		Section VI.	7 .69
July.	7 .41		Section VII. . . *(hottest.)*	7 .59
August. . . .	7 .87		Section VIII.	8 .01
September. .	7 .26		Section IX.	6 .53
October . . .	5 .10		Section X. . . . . *(mean.)*	4 .86
November. .	4 .04		Section XI.	3 .87
December. .	3 .82		Section XII.	3 .95

The greatest difference is 8°.67, which occurs on April 25.
The smallest difference is 3°.55, which occurs on December 3.

The greatest difference that occurred in the 16 years—*at* 9 *a.m.*—was 26°, on June 4, 1842; also on May 3, 1855.

TABLE X.

ATMOSPHERIC PRESSURE FOR EACH DAY IN THE YEAR.

The construction of this Table is the same as that of Table VI. The second columns are the result of a two-fold decadal reduction. The values are those belonging to the sea level and 32° Fahr., and have been corrected for diurnal variation and index error. See page 23 for explanation respecting this last correction.

Note.—In this Table the ultimate 5 in the line of "Means" is marked according as it is above or below the real value, but this is not done in the daily values.

The sums and means of the second columns were computed with the five places of decimals resulting from the decadal reduction: the sum of the whole series of values in five decimals was identical with the sum of the original values in three decimals.

TABLE X—CONTINUED.

	SEPTEMBER.		OCTOBER.		NOVEMBER.		DECEMBER.	
	1	2	1	2	1	2	1	2
	in.	in.	in.	in.	in.	in	in.	in.
1	30.158	30.138	29.825	29.834	29.964	29.959	30.035	29.930
2	30.189	30.142	29.854	29.827	29.958	29.971	29.988	29.945
3	30.217	30.143	29.867	29.822	30.000	29.983	29.992	29.957
4	30.170	30.140	29.813	29.821	29.988	29.994	30.017	29.966
5	30.145	30.136	29.741	29.822	29.989	30.003	29.910	29.972
6	30.115	30.130	29.743	29.825	30.046	30.010	29.875	29.976
7	30.146	30.124	29.708	29.832	30.080	30.015	29.950	29.981
8	30.109	30.116	29.800	29.841	30.035	30.018	29.991	29.984
9	30.080	30.108	29.844	29.852	30.107	30.019	30.075	29.985
10	30.039	30.099	29.921	29.863	30.032	30.017	30.069	29.982
11	30.082	30.091	29.894	29.874	29.985	30.011	30.058	29.978
12	30.080	30.082	29.952	29.885	30.006	30.004	30.012	29.974
13	30.094	30.074	30.053	29.895	30.042	29.994	29.939	29.970
14	30.100	30.066	29.986	29.901	29.994	29.981	29.923	29.968
15	30.089	30.057	29.807	29.905	29.962	29.965	29.934	29.967
16	30.090	30.047	29.851	29.908	29.920	29.948	29.918	29.967
17	30.055	30.035	29.818	29.910	29.998	29.931	29.902	29.968
18	29.996	30.023	29.913	29.911	29.963	29.913	29.858	29.971
19	30.000	30.010	29.956	29.912	29.945	29.895	29.943	29.977
20	29.971	29.996	29.958	29.912	29.817	29.879	30.010	29.987
21	29.974	29.981	29.951	29.911	29.884	29.866	30.078	30.000
22	30.011	29.965	30.009	29.909	29.725	29.855	30.065	30.014
23	29.956	29.949	29.883	29.906	29.776	29.850	29.993	30.028
24	29.943	29.933	29.843	29.905	29.721	29.850	30.056	30.041
25	29.905	29.917	29.798	29.908	29.814	29.855	30.028	30.052
26	29.928	29.902	29.871	29.912	29.810	29.863	30.020	30.059
27	29.895	29.886	29.934	29.918	29.869	29.873	30.023	30.064
28	29.830	29.870	29.932	29.923	29.869	29.884	30.082	30.065
29	29.808	29.856	29.948	29.929	29.892	29.898	30.233	30.063
30	29.799	29.843	29.909	29.937	29.970	29.915	30.190	30.054
31			29.915	29.947			30.235	30.041
SUMS.	900.974	900.859	926.297	926.457	898.161	898.218	930.402	929.887
MEANS.	30.032	30.029	29.881	29.886	29.939	29.941	30.013	29.996

TABLE XI.

AMOSPHERIC PRESSURE FOR EACH DIVISION OF THE YEAR.

The particulars in this Table are the amounts of Atmospheric Pressure in values belonging to 32° Fahr., the sea level, and the diurnal mean, corrected for index error, and then reduced by a two-fold decadal reduction.

MEAN ATMOSPHERIC PRESSURE FOR THE YEAR				29.9702 in.
Winter....	29.9732 in.	*Meteorological.*	Winter	29.9917 in.
Spring	29.9630		Spring...........	29.9496
Summer ...	29.9933		Summer..........	30.0120
Autumn...	29.9509		Autumn..........	29.9273
January ...	29.9416 in.		Section I. .... (coldest.)	29.9753 in.
February ..	29.9828		Section II.	30.0273
March	29.9980		Section III.	29.9127
April.....	29.9365		Section IV .... (mean.)	29.9490
May......	29.9538		Section V.........	29.9860
June	29.9929		Section VI.	29.9936
July......	29.9871		Section VII ...(hottest.)	29.9662
August....	29.9997		Section VIII.......	30.0902
September..	30.0286		Section IX.	29.9317
October ...	29.8857		Section X. .... (mean.)	29.9139
November..	29.9406		Section XI........	29.9461
December..	29.9964		Section XII.	29.9717

The maximum pressure is 30.143 in., which occurs on September 3.
The minimum pressure is 29.821 in., which occurs on October 4.

The greatest pressure that occurred in the 16 years—*at* 9 *a.m.*—was 30.912 in., on February 11, 1849.

The least pressure that occurred in the 16 years—*at* 9 *a.m.*—was 28.491 in., on January 13, 1843.

The pressure increases on 197 days in the year.
The pressure diminishes on 168 days in the year.

TABLE XII.

ATMOSPHERIC PRESSURE FOR EVERY MONTH IN THE SIXTEEN YEARS.

This Table gives the readings reduced to the values for sea level, 32° Fahr., and corrected for diurnal variation, and index error.—See page 20 for explanation of the corrections used for index error.—The values in this Table are not affected by the decadal meaning.

	JAN.	FEB.	MARCH.	APRIL.	MAY.	JUNE.	JULY.	AUGUST.	SEPT.	OCTOBER.	NOV.	DEC.	SUMS.	MEANS.
	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.	in.
1841	29.882	29.848	29.980	29.909	29.914	29.993	29.909	29.952	29.797	29.618	29.844	29.776	358.422	29.868
1842	30.082	30.089	30.003	30.083	29.980	30.075	30.021	30.064	29.891	30.053	29.766	30.179	360.286	30.024
1843	29.877	29.669	29.930	29.878	29.828	29.889	30.023	30.014	30.218	29.831	29.928	30.441	359.526	29.960
1844	30.099	29.729	29.904	30.206	30.136	30.021	29.976	29.891	30.044	29.769	29.851	30.045	359.671	29.973
1845	29.889	30.018	30.050	29.881	29.927	29.991	29.967	29.933	29.964	30.074	29.784	29.927	359.405	29.950
1846	29.875	30.067	29.872	29.760	29.964	30.055	29.961	29.975	30.003	29.711	30.007	29.922	359.172	29.931
1847	29.909	30.001	30.058	29.859	29.949	30.004	30.105	30.069	30.045	29.989	30.068	29.877	359.933	29.994
1848	29.993	29.734	29.656	29.784	30.106	29.836	30.037	29.912	30.020	29.844	30.016	29.981	358.919	29.910
1849	29.990	30.353	30.119	29.707	29.960	30.044	29.993	30.045	29.949	29.928	29.942	30.006	360.036	30.003
1850	30.062	30.085	30.249	29.779	29.901	30.084	30.008	30.011	30.133	29.910	29.965	30.140	360.327	30.027
1851	29.868	30.093	29.832	29.928	29.094	30.111	29.923	30.106	30.233	29.944	30.000	30.344	359.476	29.956
1852	29.835	30.115	30.200	30.137	29.985	29.755	30.037	29.855	29.953	29.902	29.644	29.791	359.209	29.934
1853	29.790	29.736	29.994	29.929	29.939	29.936	29.955	30.002	30.042	29.733	30.140	29.973	359.169	29.931
1854	29.826	30.303	30.402	30.189	29.873	29.928	29.996	30.088	30.218	29.907	29.896	30.012	360.638	30.053
1855	30.205	29.763	29.728	30.132	29.867	30.038	29.935	30.056	30.152	29.703	30.043	29.935	359.557	29.963
1856	29.637	30.083	30.170	30.777	29.831	30.074	30.027	29.927	30.842	30.149	30.117	29.848	361.482	30.123
SUMS.	478.819	479.686	480.147	479.938	478.254	479.834	479.873	479.900	481.504	478.065	479.011	480.197	575.5228	
MEANS.	29.926	29.980	30.009	29.996	29.891	29.990	29.992	29.994	30.094	29.879	29.938	30.012		29.975

TABLE XIII.

DAILY CHANGE OF ATMOSPHERIC PRESSURE FOR EACH DIVISION OF THE YEAR.

The amounts given in this Table for change of atmospheric pressure are the mean values of the daily change at 9 a.m., without reference to the direction of the change,—the means of the sixteen changes, whether plus or minus, were used for the daily values; and the daily values thus determined were reduced by a two-fold decadal reduction.

MEAN DAILY CHANGE FOR THE YEAR				0.159 in.
Winter	.1969 in.	*Meteorological*	Winter	.1938 in.
Spring	.1515		Spring	.1433
Summer	.1250		Summer	.1222
Autumn	.1639		Autumn	.1769
January	.2039 in.		Section I. (coldest.)	.1885 in.
February	.1885		Section II.	.1786
March	.1714		Section III.	.1602
April	.1482		Section IV. (mean.)	.1399
May	.1349		Section V.	.1264
June	.1264		Section VI.	.1229
July	.1227		Section VII. (hottest.)	.1270
August	.1259		Section VIII.	.1143
September	.1284		Section IX.	.1484
October	.1798		Section X. (mean.)	.1799
November	.1828		Section XI.	.1881
December	.1952		Section XII.	.2027

The maximum change is .210, which occurs on December 21.
The minimum change is .105, which occurs on September 4.

The greatest change observed for any one day was 1.003, on December 18, 1854: the change was one of decrement.

TABLE XIV.

DAILY CHANGE OF ATMOSPHERIC PRESSURE FOR EACH DIVISION OF THE YEAR.

The amounts in this Table give the changes as computed upon the values in Table X., but the computation was made with the values prior to their reduction from five to three decimals: the result is here necessarily very different from what it is in Table XIII.

MEAN DAILY CHANGE FOR THE YEAR.				.0063 in.		
Winter. . . .	.0059 in.	*Meteorological*	Winter	.0073 in.	Sums of Falling Values.	Sums of Rising Values.
Spring	.0069		Spring.	.0050		
Summer . . .	.0038		Summer.	.0043		
Autumn . . .	.0086		Autumn.	.0086		
January . . .	.0065 in.		Section I. . . . *(coldest.)*	.0031 in.	.036in.	.058in.
February . .	.0043		Section II.	.0139	.222	.152
March	.0115		Section III.	.0046	.028	.097
April	.0043		Section IV. . . . *(mean.)*	.0028	.058	.025
May.	.0048		Section V.	.0049	.057	.094
June	.0029		Section VI.	.0018	.032	.026
July.	.0018		Section VII. . . *(hottest.)*	.0030	.054	.037
August. . . .	.0069		Section VIII.	.0089	.153	.061
September. .	.0103		Section IX.	.0111	.162	.005
October . . .	.0053		Section X. . . . . *(mean.)*	.0064	.007	.184
November. .	.0102		Section XI.	.0085	.287	.152
December . .	.0068		Section XII.	.0078	.166	.149

The maximum change is a fall of .0231, on March 16.
The maximum rise is .0199, which occurs on March 2.

The pressure diminishes on 168 days:—the average diminution being .0068.
The pressure increases on 197 days:—the average increase being .0058.

The change in March gives 18 days of − .0127 per diem, and 13 days of + .0010.
The change in September gives 27 days of − .0111 per diem, and 3 days of + .0036.
The change in November gives 15 days of − .0113 per diem, and 15 days of + .0091.

TABLE XVI.

	JANUARY.		FEBRUARY.		MARCH.		APRIL.	
	1	2	1	2	1	2	1	2
1	.103in.	.082in.	.109in.	.085in.	.143in.	.083in.	.095in.	.068in.
2	.066	.084	.062	.083	.054	.078	.130	.068
3	.044	.088	.113	.081	.082	.074	.015	.067
4	.176	.093	.015	.078	.043	.068	.103	.066
5	.096	.097	.100	.078	.075	.063	.099	.065
6	.156	.101	.052	.077	.062	.058	.026	.064
7	.079	.103	.028	.077	.026	.054	.047	.063
8	.096	.107	.125	.077	.016	.052	.026	.062
9	.053	.110	.120	.076	.019	.051	.034	.061
10	.107	.114	.035	.073	.083	.051	.100	.061
11	.132	.118	.110	.072	.042	.051	.034	.061
12	.131	.121	.090	.070	.050	.053	.089	.061
13	.201	.124	.041	.068	.013	.055	.059	.062
14	.089	.124	.111	.067	.056	.058	.098	.063
15	.145	.125	.051	.065	.084	.062	.064	.063
16	.097	.126	.029	.064	.044	.065	.050	.063
17	.114	.128	.054	.065	.156	.068	.063	.065
18	.132	.129	.007	.065	.042	.069	.010	.065
19	.182	.129	.066	.067	.032	.070	.082	.067
20	.110	.127	.051	.071	.104	.071	.074	.068
21	.141	.124	.063	.075	.061	.071	.062	.069
22	.157	.121	.072	.079	.108	.071	.107	.069
23	.060	.117	.122	.083	.101	.071	.071	.069
24	.086	.115	.095	.086	.064	.070	.030	.068
25	.206	.113	.130	.088	.015	.068	.092	.068
26	.114	.108	.137	.089	.062	.068	.120	.067
27	.058	.103	.064	.088	.083	.068	.061	.066
28	.116	.099	.087	.086	.045	.068	.052	.067
29	.070	.093			.057	.068	.092	.067
30	.042	.090			.065	.068	.022	.068
31	.125	.088			.061	.068		
SUMS.	3.484	3.401	2.139	2.133	1.948	2.013	2.007	1.961
MEANS.	.112	.110	.076	.076	.063	.065	.067	.065

TABLE XVI—CONTINUED.

	MAY.		JUNE.		JULY.		AUGUST.	
	1	2	1	2	1	2	1	2
1	.026in.	.070in.	.068in.	.062in.	.058in.	.065in.	.092in.	.076in.
2	.062	.072	.030	.061	.044	.065	.068	.078
3	.042	.075	.055	.060	.069	.064	.130	.081
4	.056	.078	.032	.060	.051	.062	.105	.082
5	.036	.080	.011	.061	.068	.061	.111	.084
6	.159	.083	.039	.065	.053	.059	.107	.086
7	.187	.086	.099	.068	.019	.057	.039	.086
8	.143	.085	.101	.072	.069	.056	.060	.086
9	.104	.083	.080	.074	.039	.057	.087	.087
10	.074	.080	.061	.078	.112	.059	.017	.087
11	.044	.077	.109	.080	.077	.061	.148	.089
12	.035	.074	.035	.082	.035	.063	.135	.089
13	.050	.072	.150	.083	.018	.065	.060	.089
14	.062	.070	.093	.082	.096	.068	.103	.090
15	.023	.068	.117	.081	.018	.070	.112	.093
16	.095	.066	.070	.077	.032	.074	.040	.096
17	.064	.065	.115	.074	.095	.078	.118	.100
18	.064	.065	.019	.069	.102	.082	.100	.102
19	.046	.066	.101	.067	.140	.084	.071	.104
20	.100	.069	.043	.065	.203	.084	.057	.105
21	.063	.071	.035	.063	.057	.081	.136	.105
22	.095	.073	.010	.061	.040	.079	.078	.104
23	.037	.073	.026	.061	.033	.077	.176	.104
24	.108	.074	.071	.062	.097	.075	.273	.102
25	.057	.074	.059	.063	.098	.074	.119	.097
26	.101	.073	.076	.065	.100	.072	.054	.091
27	.032	.072	.051	.066	.040	.070	.043	.084
28	.092	.070	.162	.068	.015	.068	.081	.079
29	.108	.069	.109	.067	.027	.068	.020	.072
30	.110	.067	.031	.066	.031	.070	.001	.067
31	.027	.064			.097	.073	.003	.064
SUMS.	2.302	2.264	2.058	2.063	2.033	2.141	2.744	2.759
MEANS.	.074	.073	.069	.069	.066	.069	.089	.089

TABLE XVI—CONTINUED.

	SEPTEMBER.		OCTOBER.		NOVEMBER.		DECEMBER.	
	1	2	1	2	1	2	1	2
1	.075in.	.063in.	.157in.	.194in.	.106in.	.123in.	.082in.	.118in.
2	.161	.062	.139	.196	.114	.112	.037	.111
3	.052	.061	.183	.197	.134	.102	.109	.106
4	.078	.061	.162	.196	.028	.092	.029	.101
5	.015	.062	.350	.194	.018	.086	.145	.098
6	.034	.063	.218	.187	.036	.084	.138	.096
7	.019	.065	.245	.180	.093	.083	.089	.094
8	.079	.067	.140	.170	.108	.083	.139	.093
9	.165	.070	.105	.162	.105	.084	.060	.091
10	.085	.069	.111	.156	.042	.084	.056	.091
11	.071	.067	.149	.152	.068	.088	.033	.093
12	.057	.066	.140	.148	.109	.092	.105	.096
13	.065	.067	.027	.143	.045	.097	.124	.098
14	.033	.068	.109	.141	.164	.103	.044	.098
15	.052	.069	.165	.139	.144	.110	.098	.099
16	.075	.071	.293	.143	.099	.115	.129	.101
17	.037	.073	.140	.144	.043	.120	.150	.101
18	.083	.075	.088	.146	.128	.127	.128	.101
19	.074	.080	.135	.150	.127	.134	.154	.100
20	.047	.088	.164	.154	.187	.140	.129	.098
21	.139	.098	.124	.157	.108	.145	.055	.094
22	.099	.108	.054	.160	.177	.149	.036	.089
23	.113	.118	.139	.165	.153	.152	.068	.086
24	.080	.128	.184	.168	.237	.152	.086	.083
25	.098	.138	.401	.171	.190	.150	.080	.080
26	.088	.151	.194	.167	.183	.147	.069	.077
27	.125	.164	.146	.162	.132	.142	.077	.076
28	.342	.178	.173	.156	.088	.137	.128	.076
29	.300	.187	.150	.148	.180	.132	.035	.075
30	.241	.193	.146	.140	.152	.125	.055	.076
31			.132	.132			.020	.078
SUMS.	2.982	2.830	5.063	5.018	3.498	3.490	2.687	2.874
MEANS.	.099	.094	.163	.162	.117	.116	.087	.093

TABLE XVII.

FALL OF RAIN FOR EACH DIVISION OF THE YEAR.

This Table gives the mean daily fall of rain for each division; also the average gross quantity collected during each division. The daily values used for the computations had been reduced by a two-fold decadal reduction.

MEAN DAILY FALL OF RAIN FOR THE YEAR. 0.090 in.
AVERAGE FALL OF RAIN DURING THE YEAR. 32.945 in.

	Per Diem.	In the Quarter.			Per Diem.	In the Quarter.
Winter....	.093in.	8.408 in.	Meteorological	Winter	.087 in	7.935 in.
Spring	.068	6.238		Spring...........	.070	6.473
Summer ...	.076	6.963		Summer..........	.075	6.797
Autumn ...	.124	11.338		Autumn..........	.130	11.742
	Per Diem.	**In the Month.**			**Per Diem.**	**In the Section.**
January ...	.110in.	3.401 in.		Section I.... *(coldest.)*	.080 in	2.390 in.
February ..	.076	2.133		Section II.........	.068	1.833
March	.065	2.013		Section III.	.065	1.765
April.....	.065	1.961		Section IV. ... *(mean.)*	.072	2.162
May......	.073	2.264		Section V.........	.071	2.204
June	.069	2.063		Section VI.	.066	2.108
July......	.069	2.141		Section VII... *(hottest.)*	.083	2.492
August....	.089	2.759		Section VIII.......	.077	1.850
September..	.094	2.830		Section IX.	.134	3.218
October ...	.162	5.018		Section X..... *(mean.)*	.146	4.369
November. .	.116	3.490		Section XI.	.111	4.458
December..	.093	2.874		Section XII.	.102	4.098

The maximum fall occurs on October 3, and amounts to .197 in.
The minimum fall occurs on March 10, and amounts to .051 in.

The greatest fall that occurred in one year was 47.59 in., in 1852.
The smallest fall that occurred in one year was 20.54 in., in 1854.

The greatest fall that occurred in any one month during the sixteen years was 8.58 in., in November, 1852.

The smallest fall that occurred in any one month during the sixteen years was 0.15 in., in September, 1851.

The greatest fall that occurred in any one day during the sixteen years was 2.8 in., on August 24, 1843.—On October 5, 1852, 2.3 in. fell, and these are the only days on which so much as two inches fell.

TABLE XVIII.

FALL OF RAIN FOR EVERY MONTH IN THE SIXTEEN YEARS.

This Table gives the whole quantity of water collected during each respective month.

	JAN.	FEB.	MARCH.	APRIL.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	SUMS.	MEANS.
1841	in. 3.76	in. 2.01	in. 2·45	in. 1.28	in. 2.73	in. 2.00	in. 2.50	in. 4.25	in. 6.57	in. 7.71	in. 6.69	in. 4.05	in. 46.00	in. 3.92
1842	2.46	2.78	2.57	0.21	1.46	0.93	1.44	1.53	4.27	2.26	6.33	2.87	29.11	2.43
1843	3.04	3.02	1.17	3.00	5.75	2.09	1.31	5.02	0.91	5.40	3.94	0.72	35.37	2.95
1844	3.84	3.22	4.35	0.56	0.30	0.89	1.45	2.93	1.19	6.20	5.57	0.44	30.94	2.58
1845	3.44	2.36	0.84	1.44	2.15	1.70	2.61	1.78	2.94	2.20	4.16	2.52	28.14	2.34
1846	5.85	1.66	2.88	2.47	1.38	0.84	2.04	4.21	2.23	7.36	2.46	1.74	35.12	2.93
1847	2.86	1.54	1.49	1.59	2.38	1.33	0.95	1.26	1.56	3.19	2.40	4.86	25.41	2.12
1848	3.36	5.74	3.98	3.66	0.34	4.71	3.78	4.94	2.83	5.64	2.12	4.96	46.06	3.84
1849	3.34	1.71	1.14	3.78	2.78	1.80	2.29	1.62	4.37	3.98	1.71	4.83	33.35	2.78
1850	0.84	2.86	0.61	4.03	2.75	1.69	3.09	2.62	3.37	2.54	4.12	2.41	30.93	2.58
1851	5.12	1.27	4.00	1.76	0.85	1.82	2.46	1.44	0.15	5.45	1.10	1.33	26.75	2.23
1852	5.68	1.09	0.60	0.43	2.61	4.94	1.86	3.60	5.48	7.92	8.58	4.80	47.59	3.97
1853	5.03	0.65	1.21	3.30	1.93	2.57	2.57	2.31	2.58	7.54	1.57	0.54	31.80	2.65
1854	3.12	0.77	0.26	0.16	3.47	2.20	0.75	1.80	1.23	3.57	1.70	1.51	20.54	1.71
1855	0.28	2.20	2.47	0.32	2.39	1.45	2.66	1.83	3.02	7.10	2.10	1.81	27.63	2.30
1856	3.73	1.33	1.15	4.12	3.56	2.01	0.77	2.76	5.01	2.95	1.42	3.59	32.40	2.70
SUMS.	55.75	34.21	31.17	32.11	36.83	32.97	32.53	43.90	47.71	81.01	55.97	42.98	527.14	
MEANS.	3.48	2.14	1.95	2.01	2.30	2.06	2.03	2.74	2.98	5.06	3.50	2.69	32.95	2.75

TABLE XX.

NUMBER OF CLOUDY DAYS FOR EACH DIVISION OF THE YEAR.

The days concerned in this Table are those during which more than one half of the sky was covered with cloud. The Table is constructed on the same principles as Table XIX. The mean daily values were reduced by a two-fold decadal reduction.

MEAN PROPORTION OF CLOUDY DAYS, FOR THE YEAR $\frac{9.1}{16}$

AVERAGE NUMBER OF CLOUDY DAYS IN THE YEAR 208.

	Proportionate Number of days.	Average gross Number of Days.		Proportionate Number of Days.	Average gross Number of Days.
Winter....	$\frac{10.7}{16}$	60	*Meteorological.* Winter	$\frac{10.4}{16}$	59
Spring....	$\frac{8.0}{16}$	46	Spring	$\frac{7.7}{16}$	45
Summer...	$\frac{8.1}{16}$	47	Summer	$\frac{8.0}{16}$	45
Autumn...	$\frac{9.5}{16}$	54	Autumn	$\frac{10.3}{16}$	58
January...	$\frac{11.4}{16}$	22	Section I. *(coldest.)*	$\frac{10.3}{16}$	19
February ..	$\frac{10.1}{16}$	18	Section II.	$\frac{9.2}{16}$	16
March	$\frac{8.6}{16}$	17	Section III.....	$\frac{7.9}{16}$	13
April.....	$\frac{7.7}{16}$	14	Section IV. *(mean.)*	$\frac{7.7}{16}$	14
May......	$\frac{7.7}{16}$	15	Section V......	$\frac{7.5}{16}$	15
June	$\frac{7.6}{16}$	14	Section VI.....	$\frac{8.1}{16}$	16
July......	$\frac{8.7}{16}$	17	Section VII *(hottest.)*	$\frac{8.7}{16}$	16
August....	$\frac{8.2}{16}$	16	Section VIII. ..	$\frac{7.6}{16}$	11
September..	$\frac{7.4}{16}$	14	Section IX.....	$\frac{8.6}{16}$	13
October ...	$\frac{10.1}{16}$	20	Section X. *(mean.)*	$\frac{10.2}{16}$	19
November..	$\frac{11.0}{16}$	21	Section XI.....	$\frac{11.1}{16}$	28
December..	$\frac{11.0}{16}$	21	Section XII. ...	$\frac{11.0}{16}$	28

The most frequently cloudy day is Jan. 19, the frequency for this date being $\frac{11.5}{16}$

The least frequently cloudy day is Sept. 4, the frequency for this date being $\frac{6.0}{16}$

TABLE XXI.

DIRECTION OF THE WIND FOR EACH DIVISION OF THE YEAR.

This Table specifies the number of days out of every sixteen of the same date, that the wind blows from the respective quadrants of the compass. The daily values for each quadrant were reduced by a two-fold decadal reduction.

MEANS FOR THE YEAR.	N.E. 3.4	S.E. 2.1	S.W. 5.2	N.W. 3.9	Variable. 1.2
Winter. . . .	3.6	2.0	4.8	4.4	1.1
Spring	4.5	2.4	4.4	3.1	1.5
Summer . . .	2.3	1.7	6.7	4.1	1.2
Autumn . . .	3.3	2.3	4.9	4.1	1.0
Meteorological. Winter .	3.9	2.1	4.6	4.2	1.1
Spring. .	4.2	2.3	4.9	3.1	1.6
Summer	2.5	1.9	6.1	4.1	1.2
Autumn	3.1	2.1	5.3	4.4	0.9
January . . .	3.5	2.2	5.3	3.9	1.2
February . .	4.1	1.8	4.3	4.4	1.3
March	4.5	2.5	4.0	3.6	1.0
April	4.5	2.5	4.1	3.1	1.8
May.	4.3	2.1	5.1	2.7	1.7
June	2.7	1.8	1.5	3.8	1.2
July.	1.6	1.6	6.8	4.3	1.4
August. . . .	2.6	1.7	6.6	4.1	1.0
September. .	3.8	2.8	4.1	3.4	1.0
October . . .	2.9	2.0	5.7	4.2	0.9
November. .	3.3	2.0	4.9	4.7	1.1
December . .	3.3	2.0	4.8	5.0	0.9
Section I. . .	3.8	1.6	4.6	4.6	
Section II. .	4.7	2.3	3.9	3.7	
Section III.	4.2	2.4	4.5	3.3	
Section IV.	4.6	2.3	4.2	3.0	
Section V. .	3.5	2.0	6.2	2.9	
Section VI. .	1.7	1.8	6.6	4.4	
Section VII.	2.2	1.5	7.0	4.1	
Section VIII.	3.9	2.2	4.3	3.9	
Section IX. .	3.0	2.6	5.4	3.3	
Section X. .	3.1	2.2	5.3	4.3	
Section XI. .	3.2	1.8	5.1	4.95	
Section XII.	3.6	2.3	4.9	4.0	

Table XXII. is constructed with a view to ranging the values for the four quadrants in the same category with the values for the four semicircles. The values given to the semicircles are the sums of the values for the two quarters composing the respective semicircles as they are given in Table XXI. Under this arrangement the values given to the semicircles state the *absolute* number of days (during the sixteen years) that the atmospheric current flows within the limits of the four semicircles, respectively: they also show the mean *relative* frequency belonging to each of the two quadrants composing the respective semicircles.—Then, in order to make the values for the quadrants correlative with those given to the semicircles, the numbers belonging to the quadrants are each of them doubled. And, under this arrangement, the values in the eight columns of Table XXII. indicate the *relative* mean frequency for any point, in the respective eight divisions of the compass, adopted for this Table.

DIAGRAM EXHIBITING THE RELATIVE FREQUENCY OF THE DIFFERENT DIRECTIONS OF WIND FOR THE YEAR.

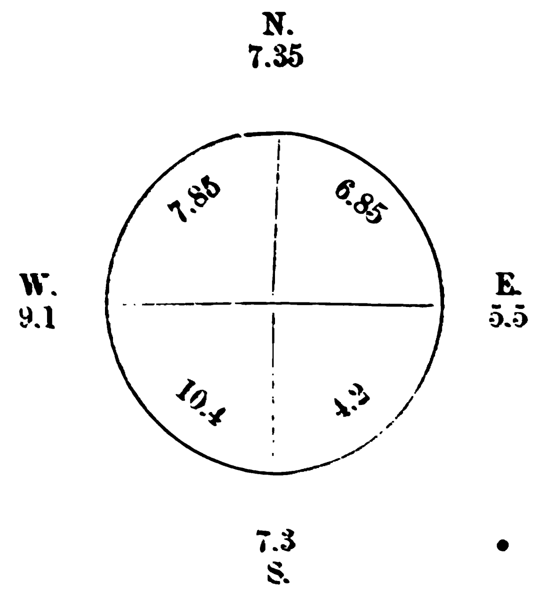


TABLE XXII.

DIRECTION OF THE WIND FOR EACH DIVISION OF THE YEAR.

This Table gives the relative values for the four semicircles and for the four quadrants.

MEANS FOR THE YEAR.	N.	S.	E.	W.	N.E.	S.E.	S.W.	N.W.
	7.35	7.3	5.5	9.1	6.85	4.2	10.4	7.85
Winter. . . .	8.0	6.8	5.6	9.2	7.2	4.0	9.6	8.8
Spring	7.6	6.8	6.8	7.6	8.9	4.8	8.8	6.3
Summer . . .	6.4	8.3	4.0	10.7	4.6	3.4	13.3	8.1
Autumn . . .	7.4	7.2	5.6	9.0	6.6	4.6	9.8	8.2
Meteorological. Winter .	8.2	6.7	6.0	8.9	7.8	4.1	9.1	8.4
Spring. .	7.3	7.3	6.5	8.1	8.3	4.6	9.8	6.1
Summer	6.6	7.8	4.4	10.1	5.1	3.7	12.1	8.2
Autumn	7.3	7.3	5.1	9.5	6.1	4.2	10.6	8.7
January . . .	7.4	7.4	5.6	9.2	7.0	4.3	10.5	7.8
February . .	8.5	6.1	5.9	8.7	8.2	3.5	8.7	8.8
March	8.1	6.6	7.0	7.6	9.0	5.0	8.1	7.2
April	7.6	6.6	7.1	7.2	9.1	5.0	8.2	6.2
May.	7.1	7.2	6.4	7.8	8.6	4.2	10.2	5.5
June	6.5	8.4	4.5	10.3	5.4	3.6	13.1	7.5
July.	6.0	8.4	3.2	11.1	3.3	3.2	13.6	8.6
August. . . .	6.7	8.2	4.2	10.7	5.2	3.3	13.2	8.2
September. .	7.2	6.9	6.6	7.5	7.6	5.7	8.2	6.7
October . . .	7.1	7.7	4.9	9.9	5.8	4.0	11.3	8.4
November. .	8.0	6.9	5.3	9.6	6.5	4.0	9.8	9.4
December. .	8.3	6.8	5.3	9.8	6.7	4.0	9.7	9.9
Section I. . .	8.4	6.2	5.5	9.15	7.7	3.3	9.1	9.2
Section II. .	8.3	6.4	7.0	7.7	9.4	4.7	7.8	7.5
Section III.	7.5	6.9	6.6	7.8	8.3	4.9	9.0	6.7
Section IV.	7.6	6.5	6.9	7.2	9.3	4.6	8.5	5.9
Section V. .	6.4	8.2	5.5	9.1	7.0	4.1	12.4	5.8
Section VI. .	6.1	8.4	3.5	11.0	3.5	3.6	13.2	8.7
Section VII.	6.3	8.5	3.7	11.1	4.4	3.0	14.0	8.2
Section VIII.	7.8	6.6	6.1	8.2	7.8	4.4	8.7	7.8
Section IX. .	6.3	8.0	5.6	8.7	6.0	5.3	10.8	6.6
Section X. .	7.4	7.5	5.3	9.6	6.1	4.4	10.6	8.6
Section XI. .	8.1	6.9	5.0	10.0	6.4	3.6	10.2	9.9
Section XII.	7.6	7.2	5.9	8.7	7.2	4.6	9.9	8.1

TABLE XXIII.

FORCE OF WIND FOR EACH DAY IN THE YEAR.

This Table involves only the four years 1853—56. The range of the scale of Force is 0—6. The first column, here, gives the *sums* of the four values, instead of the means: but, the second column being the result of a two-fold reduction—which produces two decimals—gives the *means* for the four years, and these means retain the two decimals.

TABLE XXIII.

	JANUARY.		FEBRUARY.		MARCH.		APRIL.	
	1	2	1	2	1	2	1	2
1	11	2.30	6	2.13	6	1.83	12	2.50
2	11	2.28	7	2.14	10	1.81	11	2.52
3	9	2.26	8	2.17	11	1.80	15	2.54
4	9	2.25	4	2.23	6	1.78	10	2.53
5	6	2.23	7	2.31	4	1.78	8	2.51
6	9	2.24	10	2.40	5	1.79	9	2.51
7	12	2.23	13	2.50	6	1.83	8	2.50
8	5	2.20	13	2.59	7	1.89	10	2.50
9	6	2.20	15	2.68	6	1.98	10	2.49
10	11	2.23	13	2.73	6	2.03	13	2.47
11	11	2.24	8	2.76	9	2.11	10	2.42
12	12	2.25	12	2.78	11	2.18	10	2.37
13	8	2.24	12	2.78	12	2.24	9	2.33
14	8	2.23	9	2.75	11	2.30	8	2.31
15	7	2.25	7	2.71	9	2.33	9	2.29
16	6	2.27	13	2.68	11	2.36	10	2.26
17	13	2.31	15	2.63	11	2.37	11	2.23
18	9	2.34	14	2.55	10	2.36	7	2.18
19	8	2.36	9	2.45	6	2.34	5	2.14
20	12	2.37	9	2.36	10	2.32	7	2.12
21	8	2.37	8	2.28	7	2.30	10	2.12
22	7	2.38	6	2.20	9	2.28	10	2.12
23	10	2.40	7	2.14	9	2.27	10	2.11
24	14	2.41	8	2.09	9	2.28	8	2.10
25	11	2.38	9	2.04	10	2.31	10	2.09
26	10	2.33	9	1.97	12	2.33	5	2.06
27	9	2.27	7	1.90	7	2.35	7	2.11
28	9	2.21	6	1.85	7	2.38	8	2.16
29	8	2.17			11	2.41	9	2.22
30	8	2.13			9	2.44	10	2.28
31	9	2.13			8	2.46		
SUMS.	286	70.46	264	66.80	265	67.24	279	69.09
MEANS.	9.23 2.31	2.27	9.43 2.36	2.39	8.55 2.14	2.17	9.30 2.33	2.30

TABLE XXIII—CONTINUED.

	MAY.		JUNE.		JULY.		AUGUST.	
	1	2	1	2	1	2	1	2
1	8	2.33	13	2.53	10	2.35	11	2.30
2	11	2.37	8	2.48	8	2.34	8	2.23
3	6	2.41	9	2.44	8	2.32	8	2.16
4	9	2.46	10	2.42	9	2.30	11	2.09
5	11	2.51	9	2.41	10	2.29	6	2.01
6	14	2.55	7	2.40	10	2.28	6	1.97
7	13	2.56	8	2.40	9	2.27	7	1.94
8	14	2.54	10	2.40	7	2.27	5	1.91
9	11	2.50	11	2.40	9	2.29	9	1.91
10	10	2.45	8	2.41	11	2.32	6	1.92
11	5	2.40	9	2.43	7	2.35	6	1.95
12	7	2.36	12	2.46	8	2.38	9	2.02
13	9	2.33	12	2.47	8	2.41	8	2.08
14	7	2.31	12	2.46	10	2.43	11	2.14
15	10	2.30	10	2.45	11	2.45	11	2.19
16	10	2.29	7	2.42	13	2.46	8	2.23
17	10	2.30	7	2.40	13	2.46	5	2.29
18	9	2.31	11	2.39	11	2.45	9	2.36
19	12	2.33	12	2.38	11	2.43	9	2.44
20	6	2.35	9	2.36	9	2.41	14	2.51
21	9	2.39	9	2.34	7	2.39	14	2.56
22	8	2.43	8	2.33	6	2.38	8	2.57
23	10	2.48	9	2.32	6	2.38	7	2.60
24	14	2.53	9	2.32	9	2.39	8	2.63
25	9	2.54	8	2.33	10	2.41	15	2.68
26	11	2.56	9	2.34	13	2.43	12	2.71
27	10	2.57	11	2.36	11	2.43	13	2.73
28	10	2.57	8	2.36	10	2.43	11	2.73
29	9	2.57	12	2.37	12	2.42	11	2.71
30	12	2.57	11	2.36	10	2.39	9	2.67
21	12	2.56			9	2.35	9	2.63
SUMS.	306	75.73	288	71.94	295	73.66	284	71.87
MEANS.	9.87 2.47	2.44	9.60 2.40	2.40	9.52 2.38	2.38	9.16 2.29	2.32

TABLE XXIII—CONTINUED.

	SEPTEMBER.		OCTOBER.		NOVEMBER.		DECEMBER.	
	1	2	1	2	1	2	1	2
1	12	2.60	10	2.31	8	1.86	6	1.83
2	11	2.55	8	2.28	4	1.80	8	1.90
3	11	2.47	7	2.26	6	1.75	7	1.96
4	9	2.37	16	2.25	8	1.71	6	2.02
5	13	2.29	14	2.20	7	1.66	9	2.09
6	10	2.18	6	2.13	6	1.61	13	2.17
7	8	2.08	9	2.08	5	1.57	9	2.22
8	5	1.98	8	2.04	5	1.53	9	2.27
9	7	1.90	4	2.00	5	1.51	11	2.29
10	5	1.83	7	1.98	8	1.49	12	2.30
11	6	1.77	8	1.96	8	1.47	8	2.30
12	5	1.74	8	1.95	9	1.44	6	2.29
13	8	1.73	8	1.95	5	1.39	9	2.29
14	7	1.75	4	1.95	4	1.34	12	2.29
15	5	1.78	11	1.99	3	1.31	11	2.28
16	8	1.84	5	2.03	2	1.30	4	2.25
17	7	1.92	9	2.09	4	1.32	5	2.27
18	7	2.02	7	2.14	6	1.34	14	2.30
19	9	2.12	9	2.21	7	1.35	8	2.31
20	8	2.21	12	2.26	8	1.37	10	2.32
21	7	2.28	12	2.29	3	1.38	10	2.33
22	12	2.35	10	2.30	4	1.41	10	2.34
23	11	2.40	8	2.29	3	1.46	8	2.34
24	11	2.42	7	2.28	10	1.52	10	2.35
25	13	2.45	11	2.26	8	1.57	11	2.36
26	11	2.47	11	2.23	9	1.60	12	2.36
27	12	2.46	8	2.17	3	1.62	7	2.34
28	12	2.43	11	2.11	5	1.64	8	2.31
29	6	2.38	6	2.03	8	1.70	7	2.31
30	2	2.33	6	1.96	7	1.76	9	2.30
31			10	1.89			10	2.29
SUMS.	258	65.10	270	65.87	178	45.78	279	69.58
MEANS.	8.60 2.15	2.17	8.71 2.18	2.12	5.93 1.48	1.53	9.00 2.25	2.24

TABLE XXIV.

FORCE OF WIND FOR EACH DIVISION OF THE YEAR.

The statements in this Table refer to the Force of the Wind computed with a scale ranging 0—6. The daily values were reduced by a two-fold decadal reduction. The period of observation was the four years 1853—56.

MEAN FORCE FOR THE YEAR				2.23
Winter	2.30	*Meteorological.*	Winter	2.27
Spring	2.31		Spring	2.38
Summer	2.36		Summer	2.30
Autumn	1.94		Autumn	1.96
January	2.27		Section I. *(coldest.)*	2.42
February	2.39		Section II.	2.07
March	2.17		Section III.	2.40
April	2.30		Section IV. *(mean.)*	2.30
May	2.44		Section V.	2.46
June	2.40		Section VI.	2.36
July	2.38		Section VII *(hottest.)*	2.22
August	2.32		Section VIII.	2.40
September	2.17		Section IX.	2.20
October	2.12		Section X. *(mean.)*	2.04
November	1.53		Section XI.	1.74
December	2.24		Section XII.	2.30

The decade of maximum force is February 8—17,— The value being 2.71.
The decade of next great force is August 23—1 Sept.,— The value being 2.70.
The decade of minimum force is November 13—22,— The value being 1.35.
Tne decade of next small force is Feb. 27—8 March,— The value being 1.83.

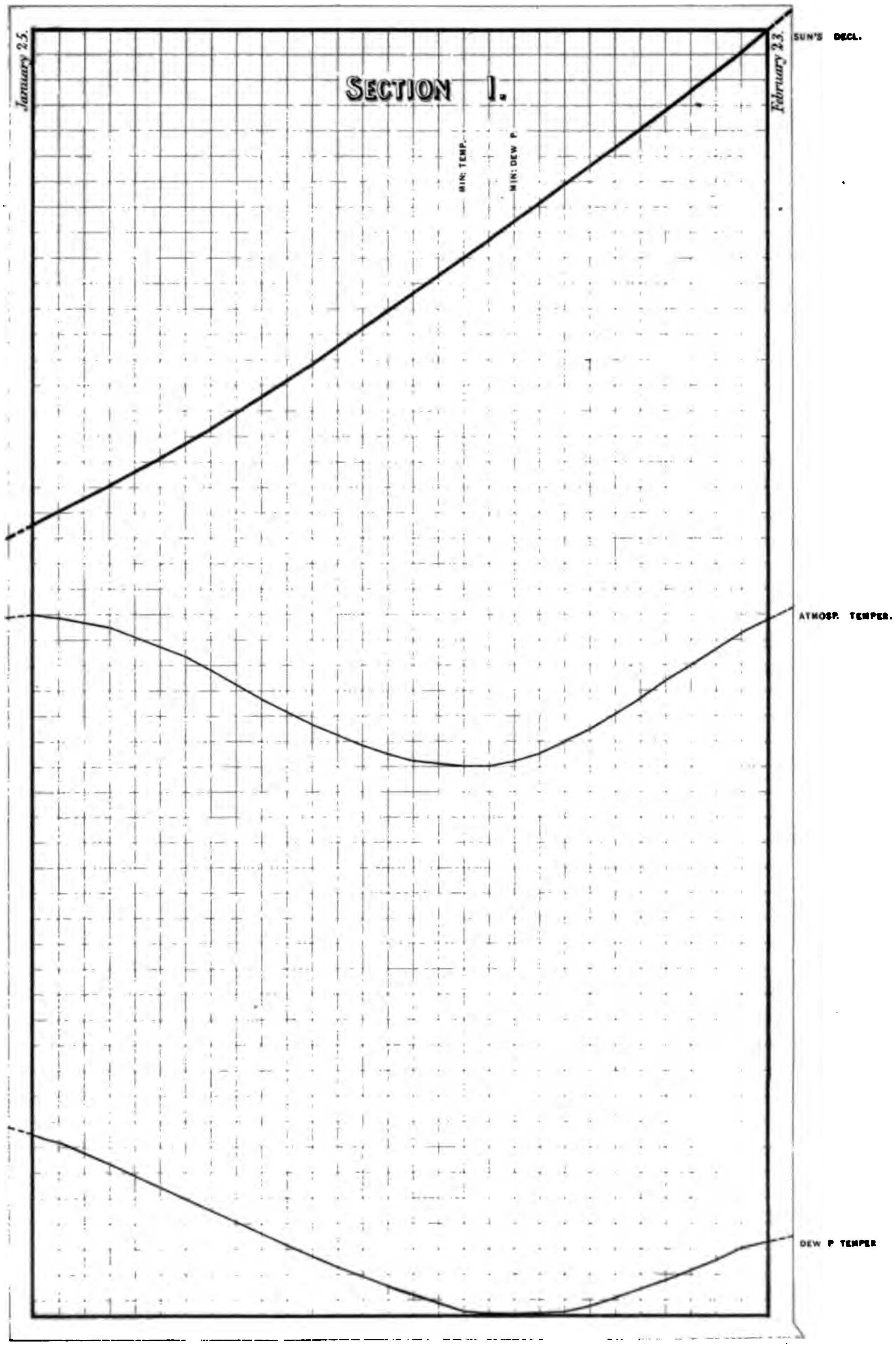
DIAGRAMS.

DIAGRAMS.

In constructing the diagrams, such scales have been adopted as would keep the meteorological particular within the same linear boundary as that for the sun's declination. The whole range of the sun's declination is divided into 100 parts, or degrees, and the daily values are calculated, and measured off in the linear projection, to the $\frac{1}{10}$ of such degree: the horizontal lines in the diagrams correspond with these degrees; the perpendicular lines represent the successive days in the year. The whole range for the other particulars is divided in the same way, into 100 parts; and the zero for the meteorological particular is made to coincide with the zero for the sun's position: so that the daily progression of the one is readily compared with that of the other all through the year. The position and the progression of the line for the dew-point temperature is determined by the scale belonging to the atmospheric temperature, so that these two particulars may be readily compared: and the interval between the two lines thus represents the difference between the two temperatures. The projection for air, and that for vapour, in the diagrams for the atmospheric pressures is drawn with the scale belonging to atmospheric pressure,—the last coinciding with that for the sun's declination, and all the four particulars starting from the same zero line.

One degree in the projection corresponds with 0°.469 for the sun's declination, with 0°.2271 for Fahrenheit's thermometer, with .003223 in. for pressure, with .0014607 in. for rain, and with .0557 of a day for cloud—the value of the one day being 1 in the 16 years.

Projections for the entire years are given in a condensed form, on a smaller scale, and in a more wholesale manner. The points adopted for laying down the lines here are;—the value belonging to the first day of each Section, the max. value in each Section, the min. value in each Section. The scale is $\frac{1}{4}$ that used for the daily values.

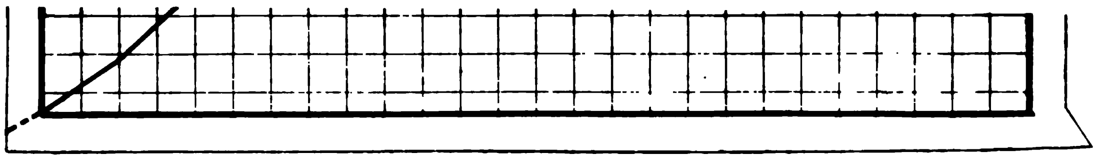

SECTION I.
January 25.
February 23.
SUN'S DECL.
MIN: TEMP.
MIN: DEW P.
ATMOSP. TEMPER.
DEW P TEMPER

TEMPERATURE.

Section 2.

TEMPERATURE.

Section 3.

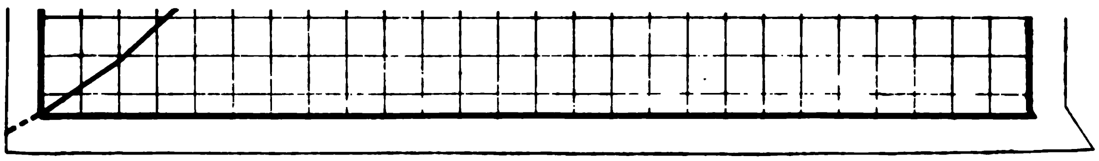


TEMPERATURE.

Section 2.

TEMPERATURE.

Section 3.



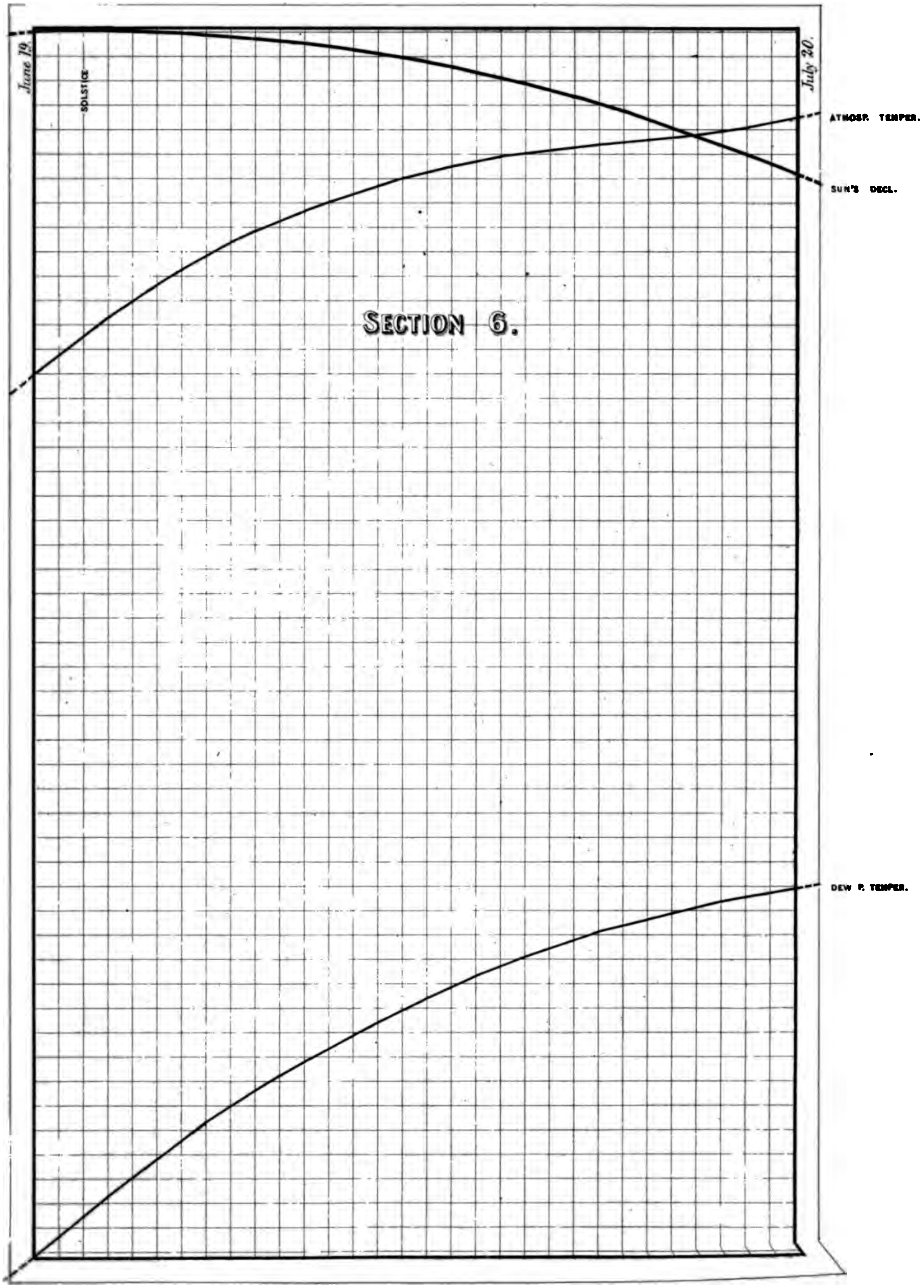
TEMPERATURE.

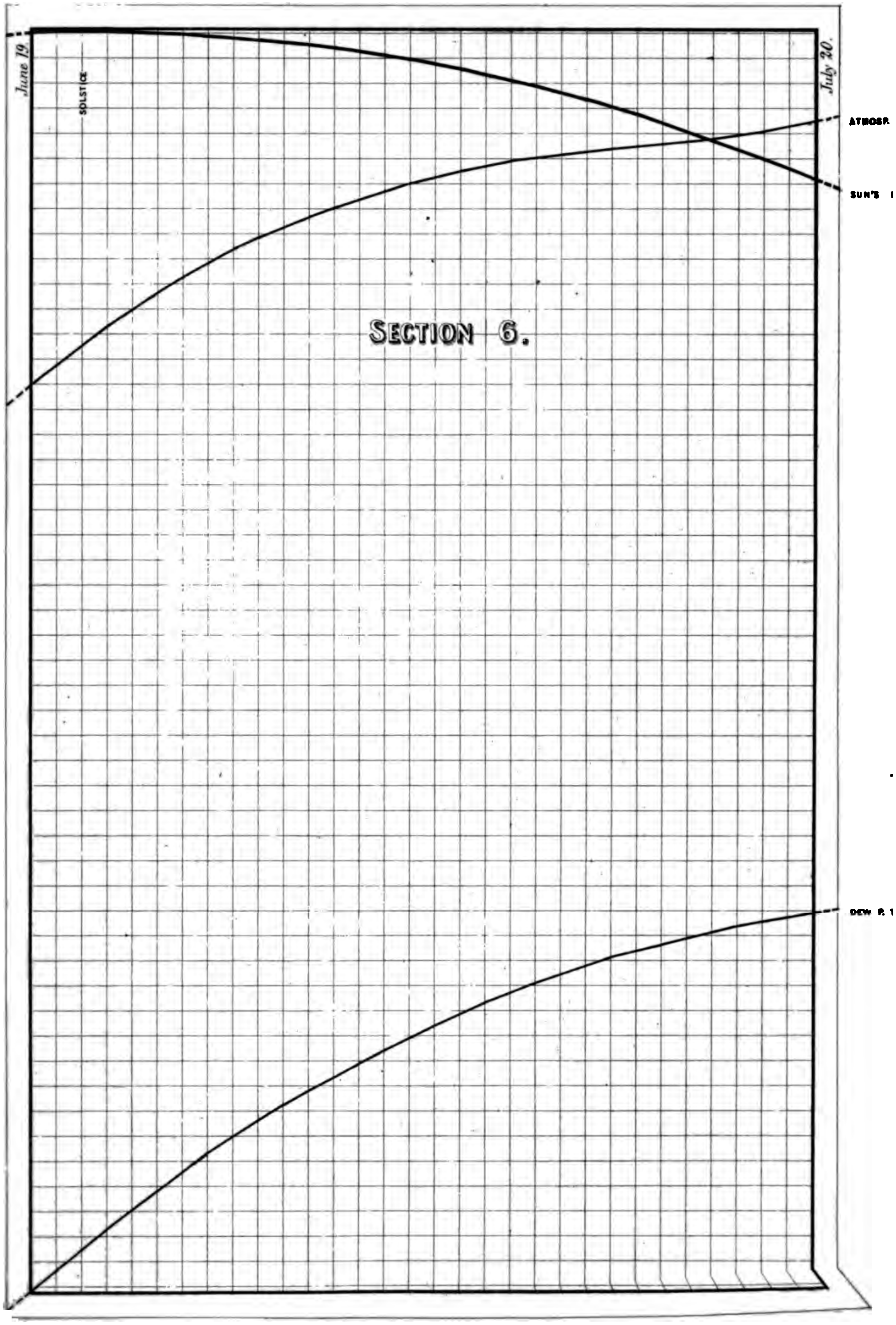
Section 4.

Section 5.

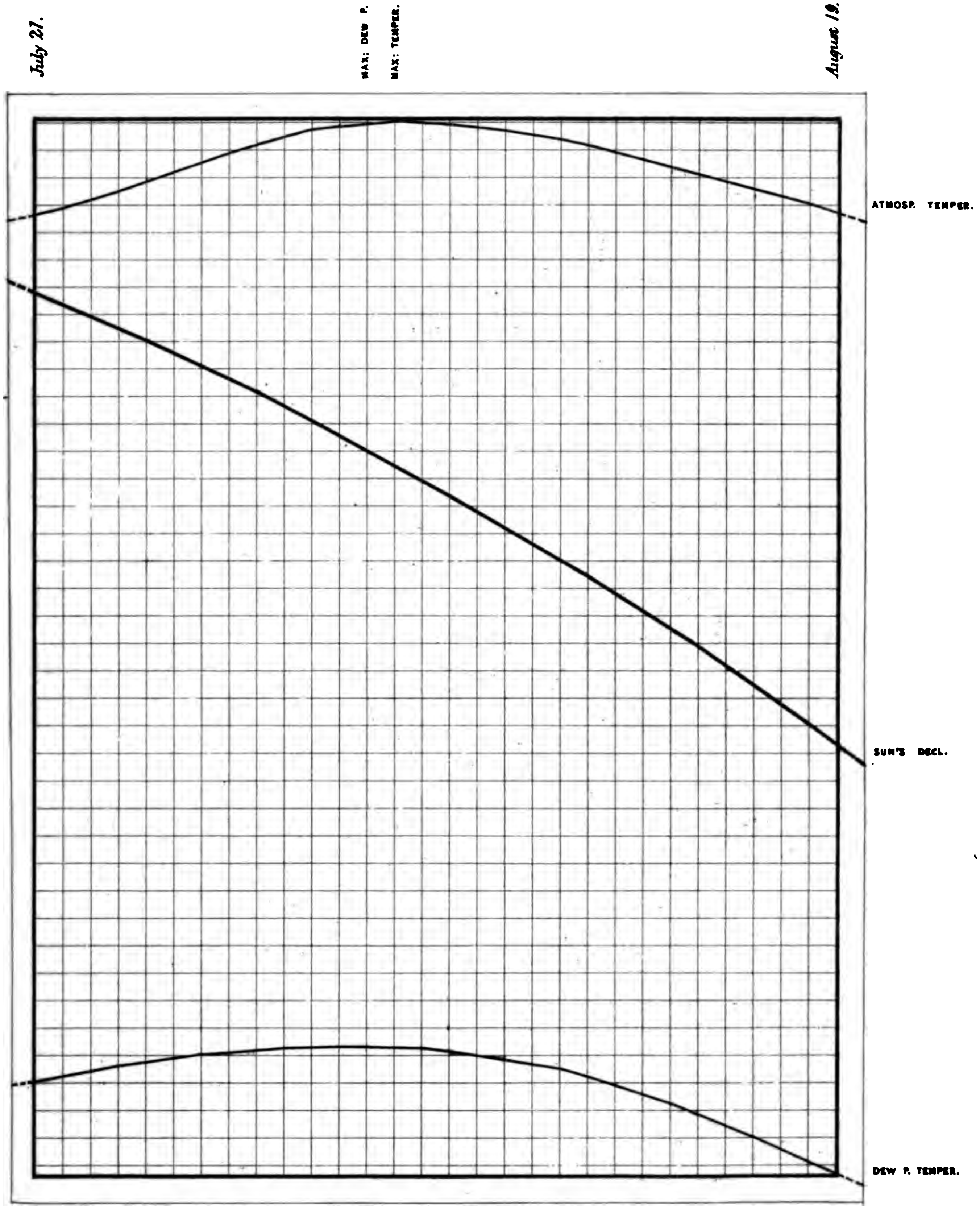
TEMPERATURE.

Section 5.


June 19.
SOLSTICE
July 20.
ATMOSP. TEMPER.
SUN'S DECL.
SECTION 6.
DEW P. TEMPER.


June 19.
SOLSTICE
July 20.
ATMOSP.
SUN'S I
SECTION 6.
DEW P. 1

SECTION 7.

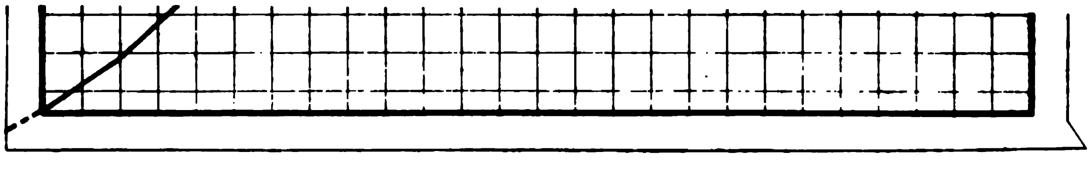

July 21.
MAX: DEW P.
MAX: TEMPER.
August 19.
ATMOSP. TEMPER.
SUN'S DECL.
DEW P. TEMPER.

TEMPERATURE.

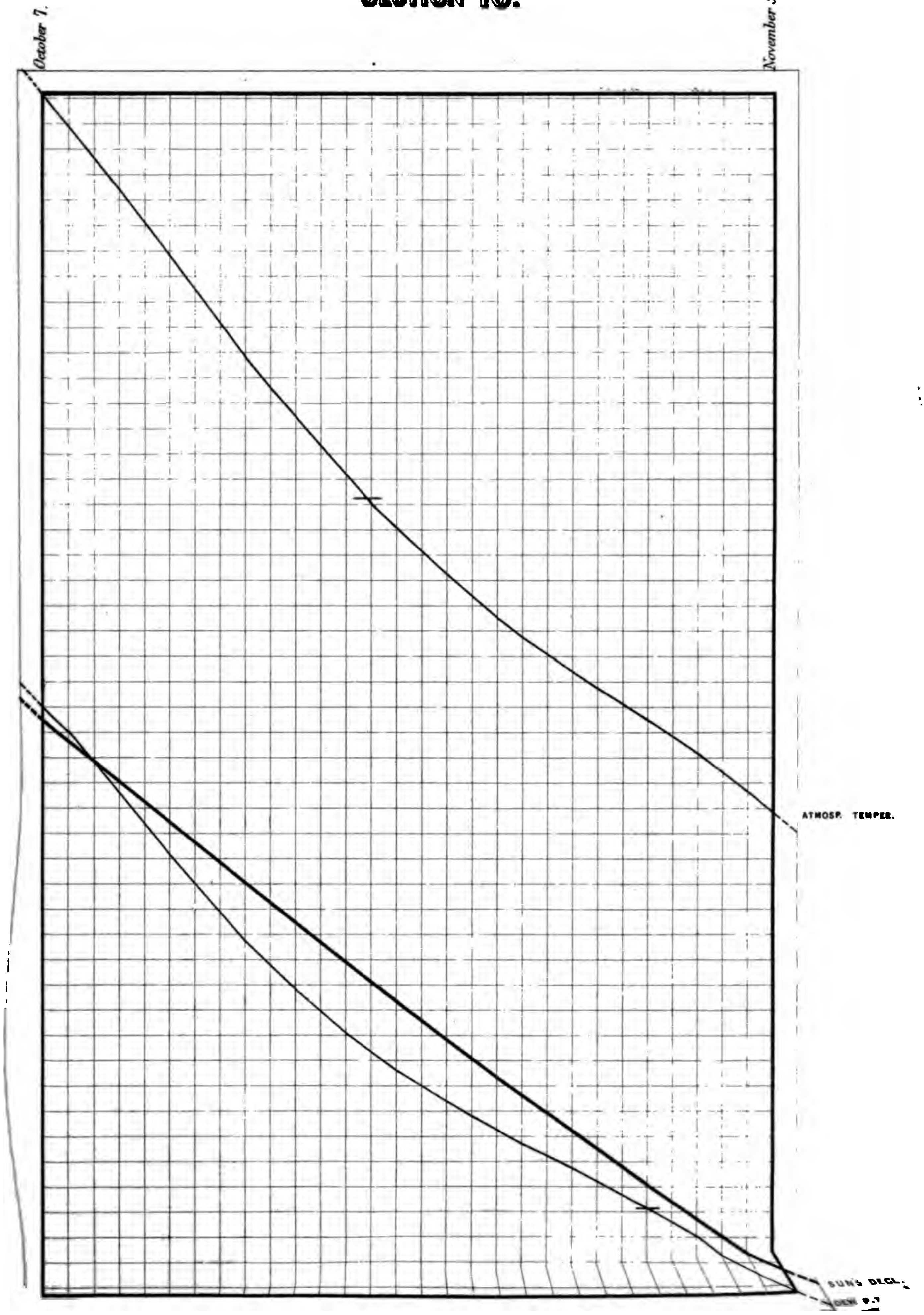
Section 2.

TEMPERATURE.

Section 3.

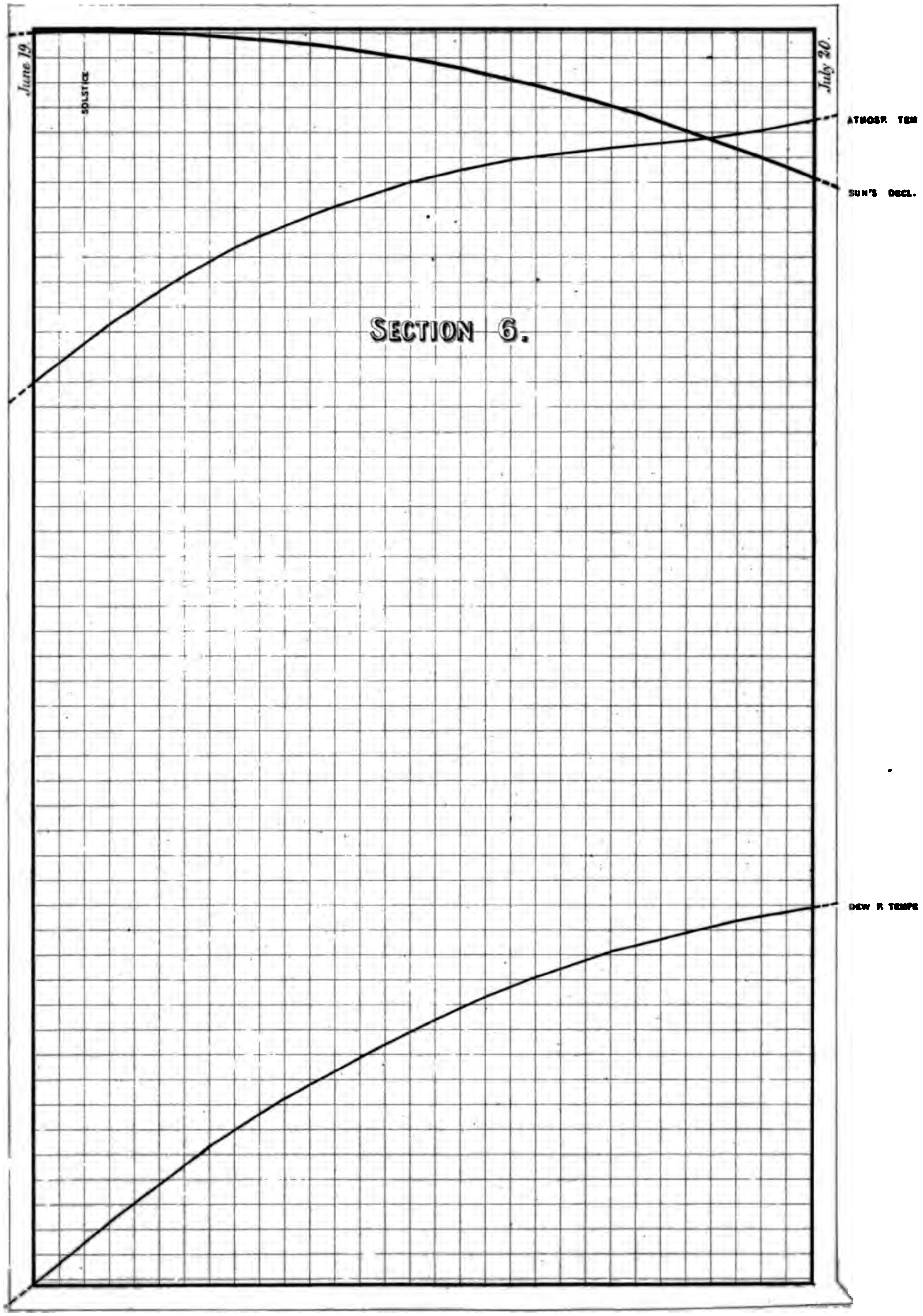


SECTION 10.



TEMPERATURE.

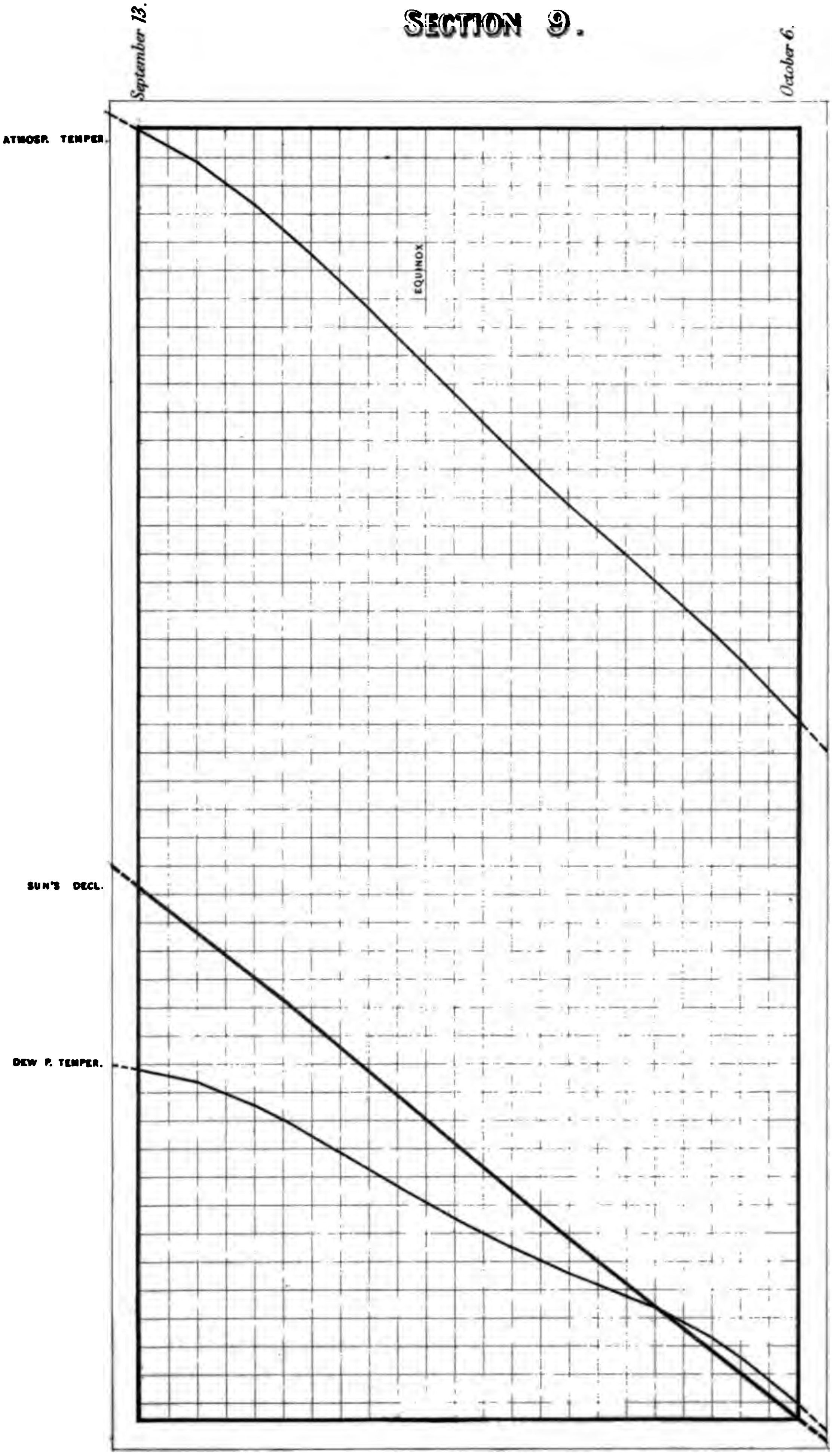
Section 5.


June 19.
SOLSTICE
SECTION 6.
July 20.
ATMOSP. TEM
SUN'S DECL.
DEW P. TEMP.

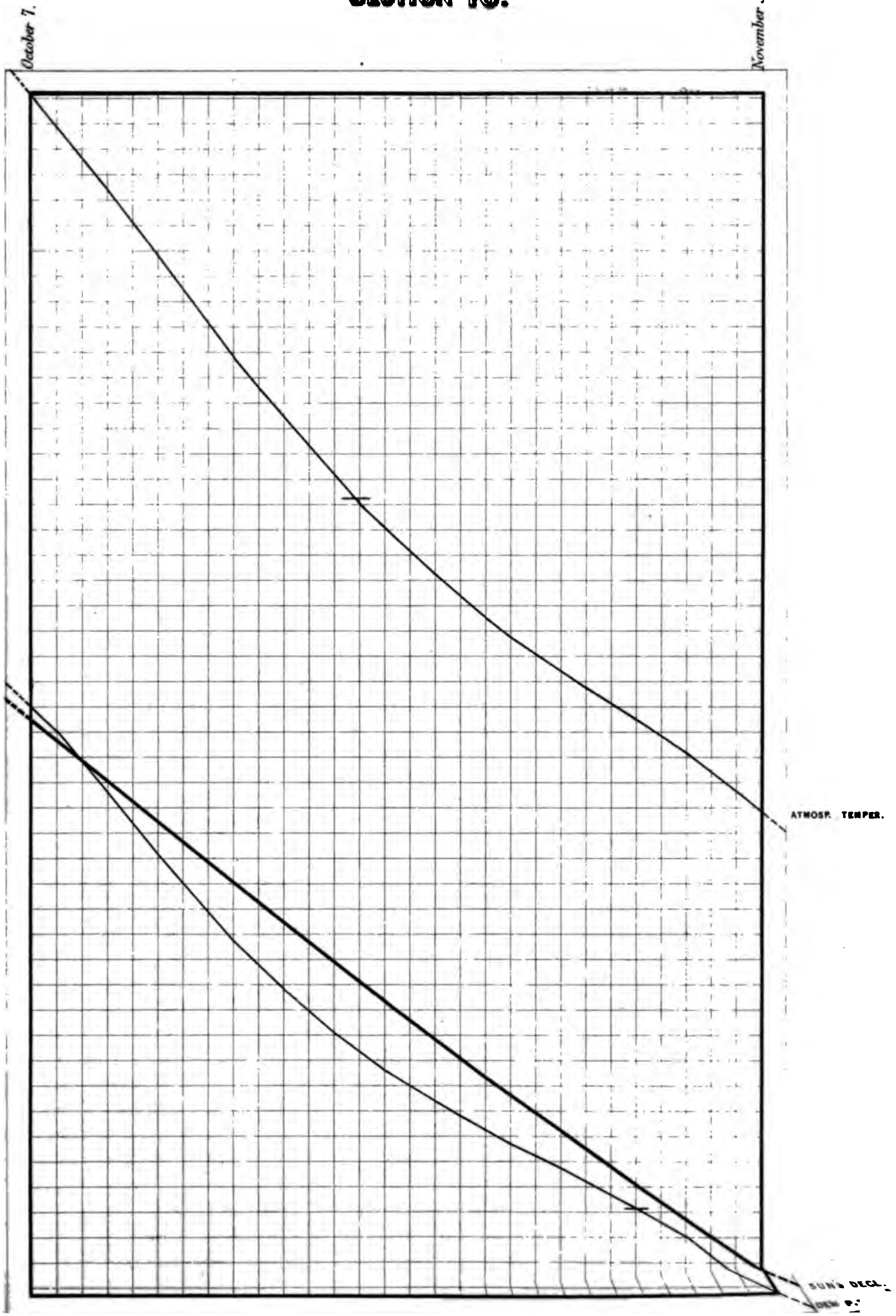
ELASTIC FORCES.

Section 1.—*No.* 2.

SECTION 9.


September 13.
October 6.
ATMOSP. TEMPER.
EQUINOX
SUN'S DECL.
DEW P. TEMPER.

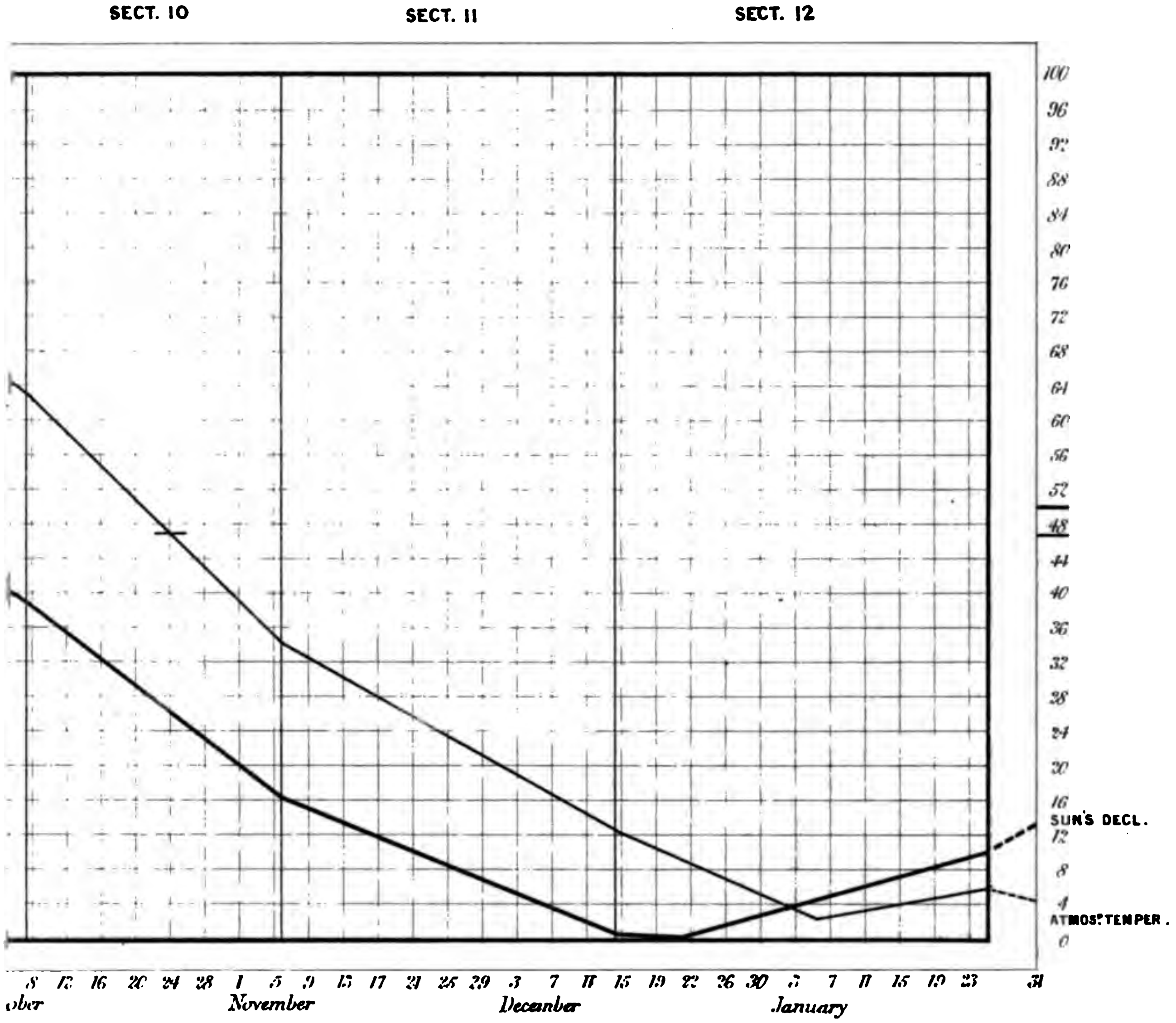
SECTION 10.



TEMPERATURE.

The Year.

ctive Sections.



Section 1.—No. 2.

ELASTIC FORCES.
Section 1.—No. 2.

ELASTIC FORCES.

Section 2.—*No.* 1.

ELASTIC FORCES.

Section 2.—*No.* 2.

ELASTIC FORCES.

Section 3.

ELASTIC FORCES.

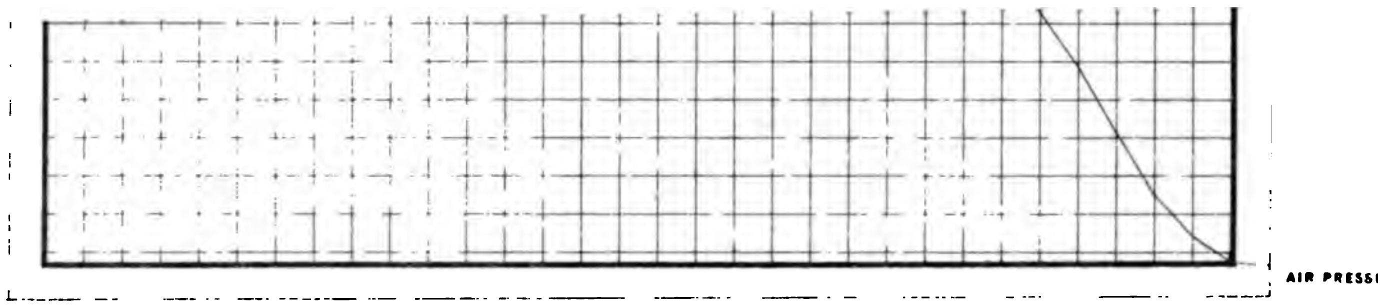
Section 4.

ELASTIC FORCES.

Section 5.

Elastic Forces.

Section 6.



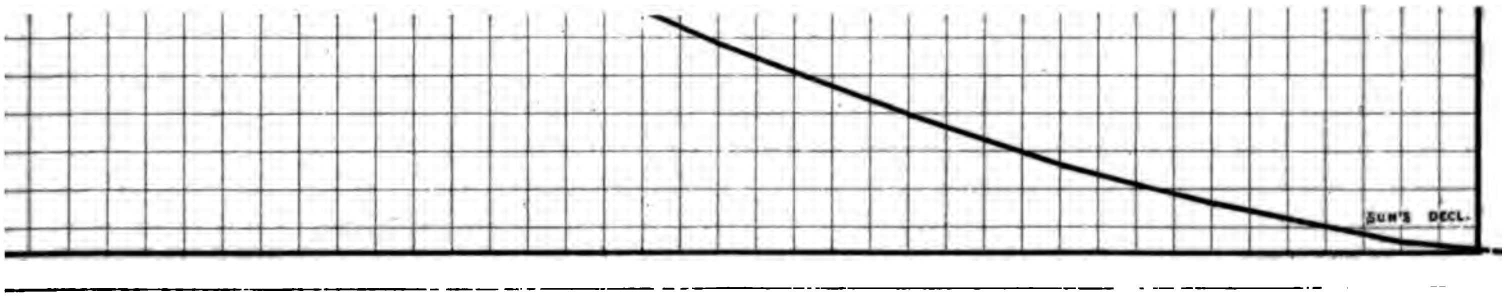
ELASTIC FORCES.

Section 7.

ELASTIC FORCES.

Section 8.

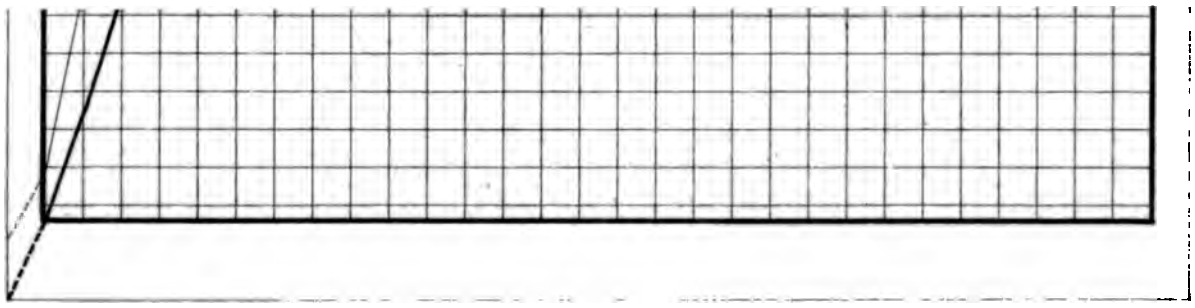
ELASTIC FORCES.
Section 11.



SECTION 9.

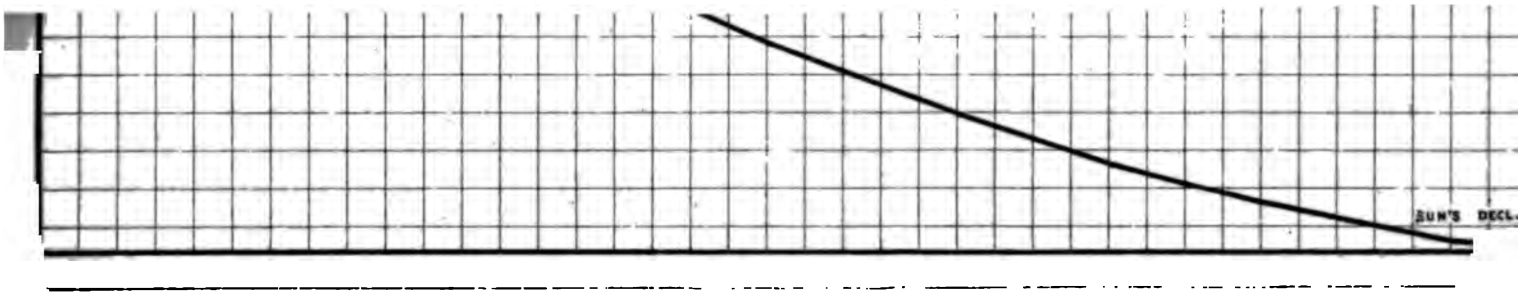
ELASTIC FORCES.

Section 10.



Elastic Forces.

Section 11.



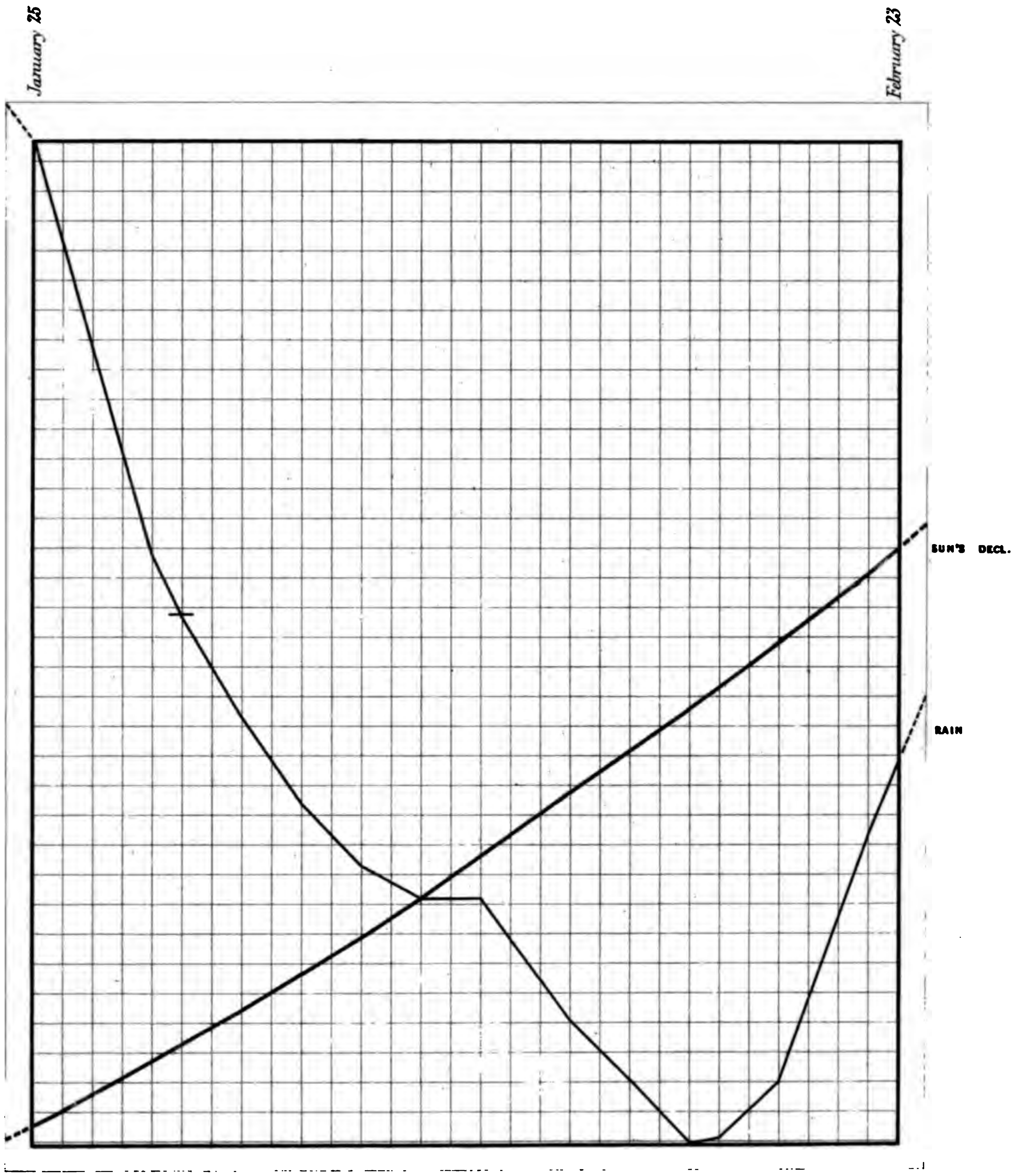
ELASTIC FORCES.

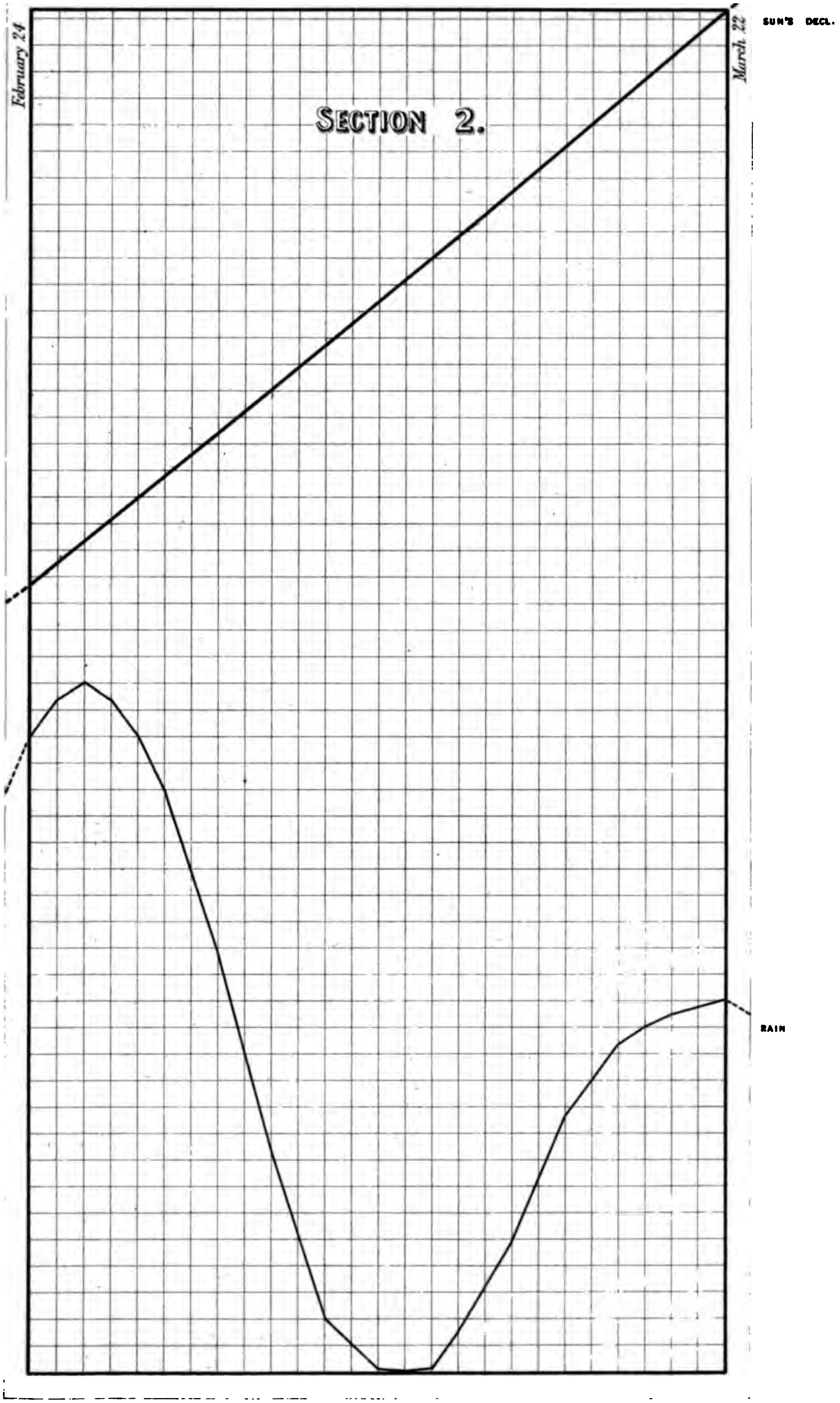
Section 12.—*No.* 1.

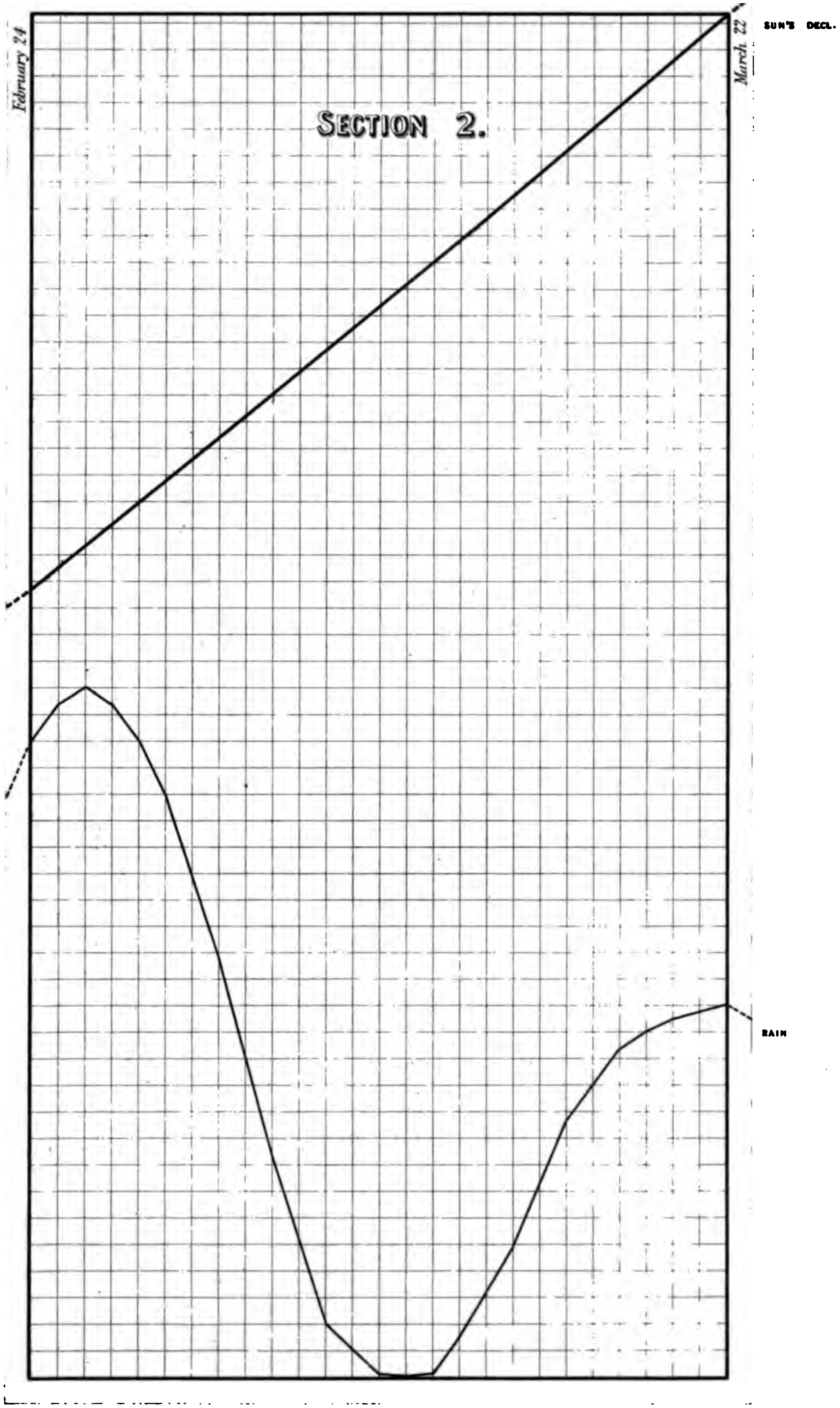
ELASTIC FORCES.

Section 12.—*No.* 2.

SECTION I.




February 24
SECTION 2.
March 22
SUN'S DECL.
RAIN


SECTION 2.
February 24
March 22
SUN'S DECL.
RAIN

RAIN.

Section 4.

RAIN.

Section 5.

RAIN.

Section 5.

RAIN.

Section 6.

RAIN.

Section 7.

RAIN.

Section 9.

RAIN.

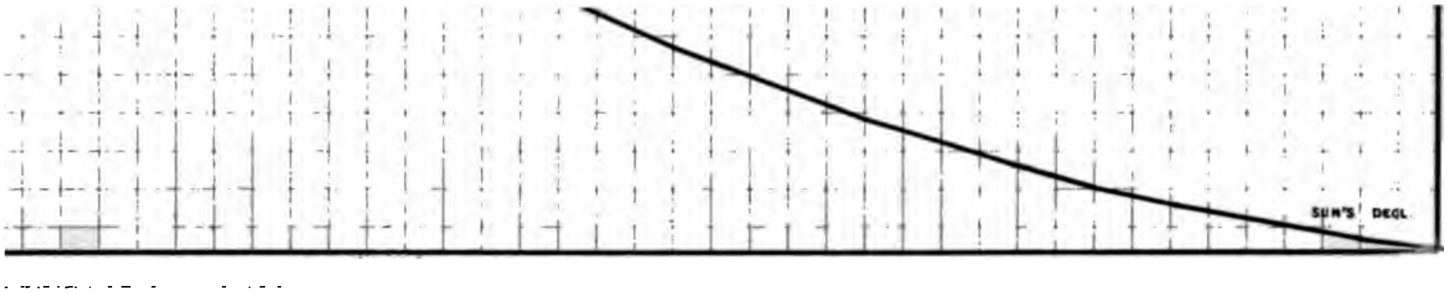
Section 9.

RAIN.

Section 10.

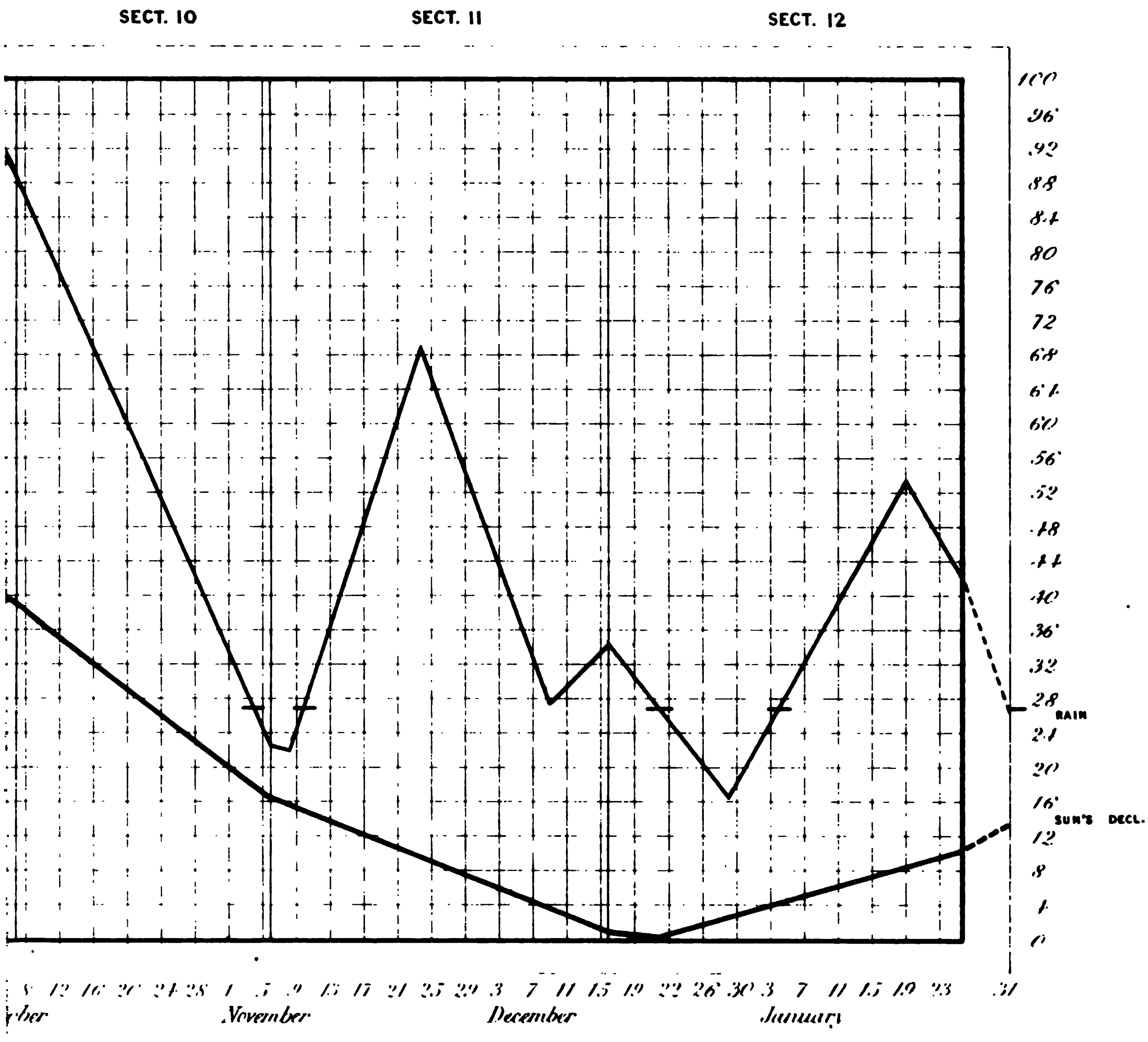
RAIN.

Section 11.



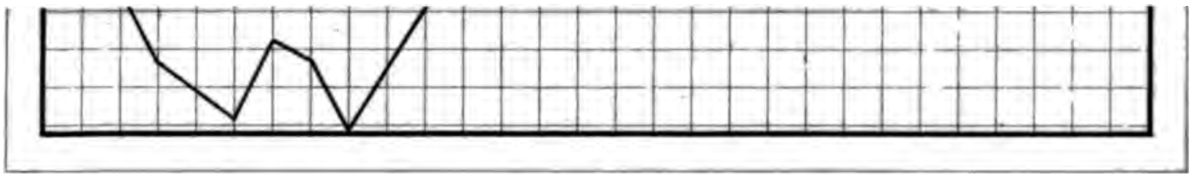
RAIN.

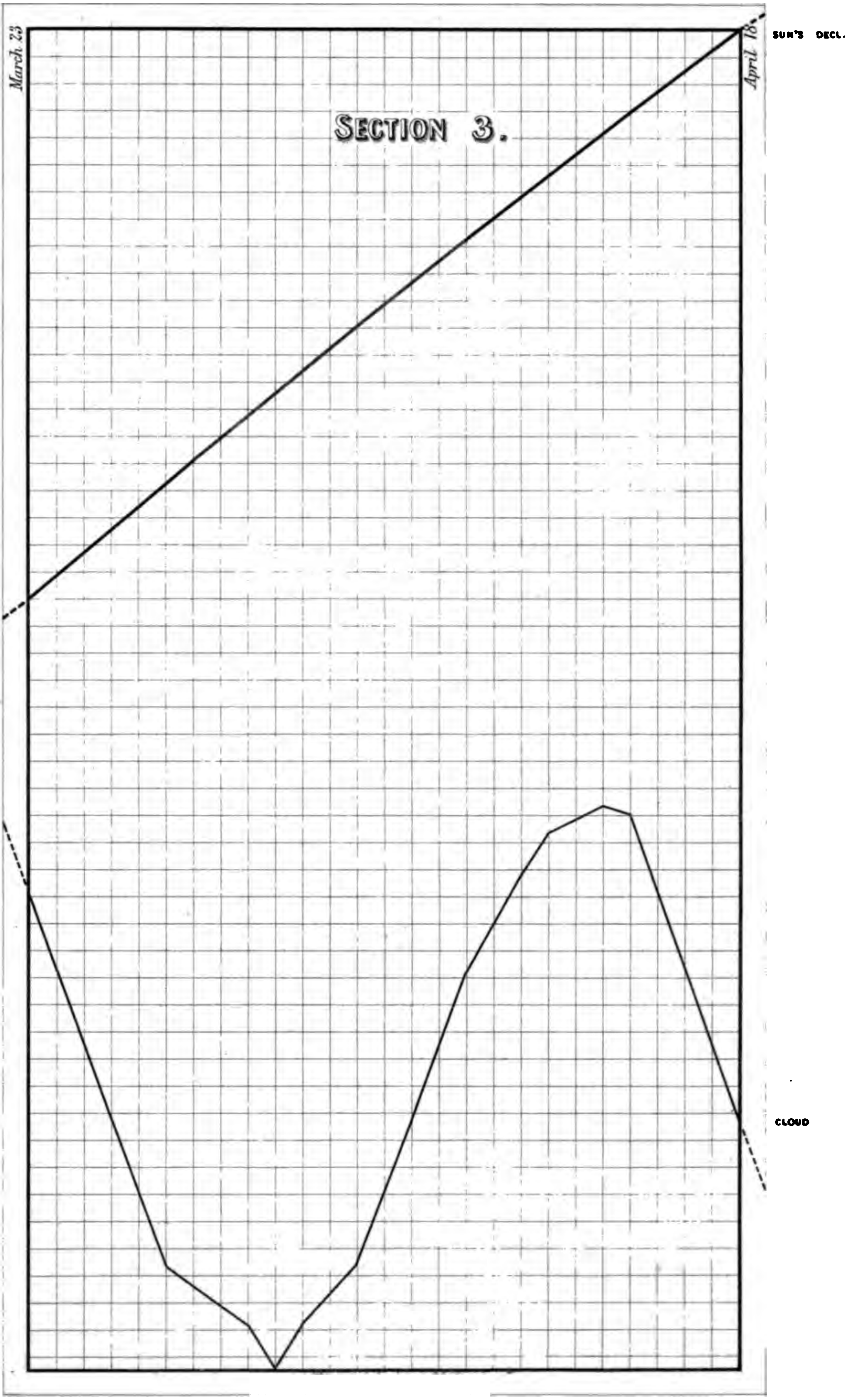
The Year.



CLOUD.

Section 4.



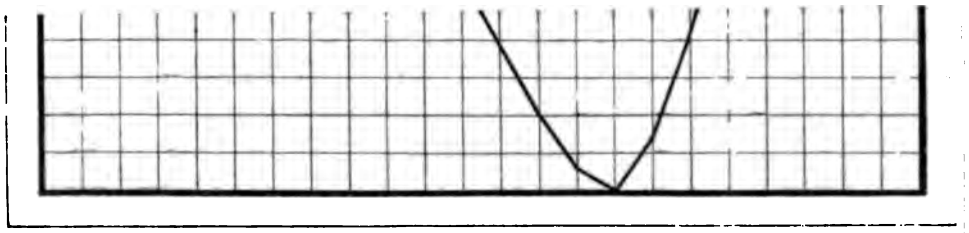

SECTION 3.
March 23
April 18
SUN'S DECL.
CLOUD

CLOUD.

Section 6.

CLOUD.

Section 8.

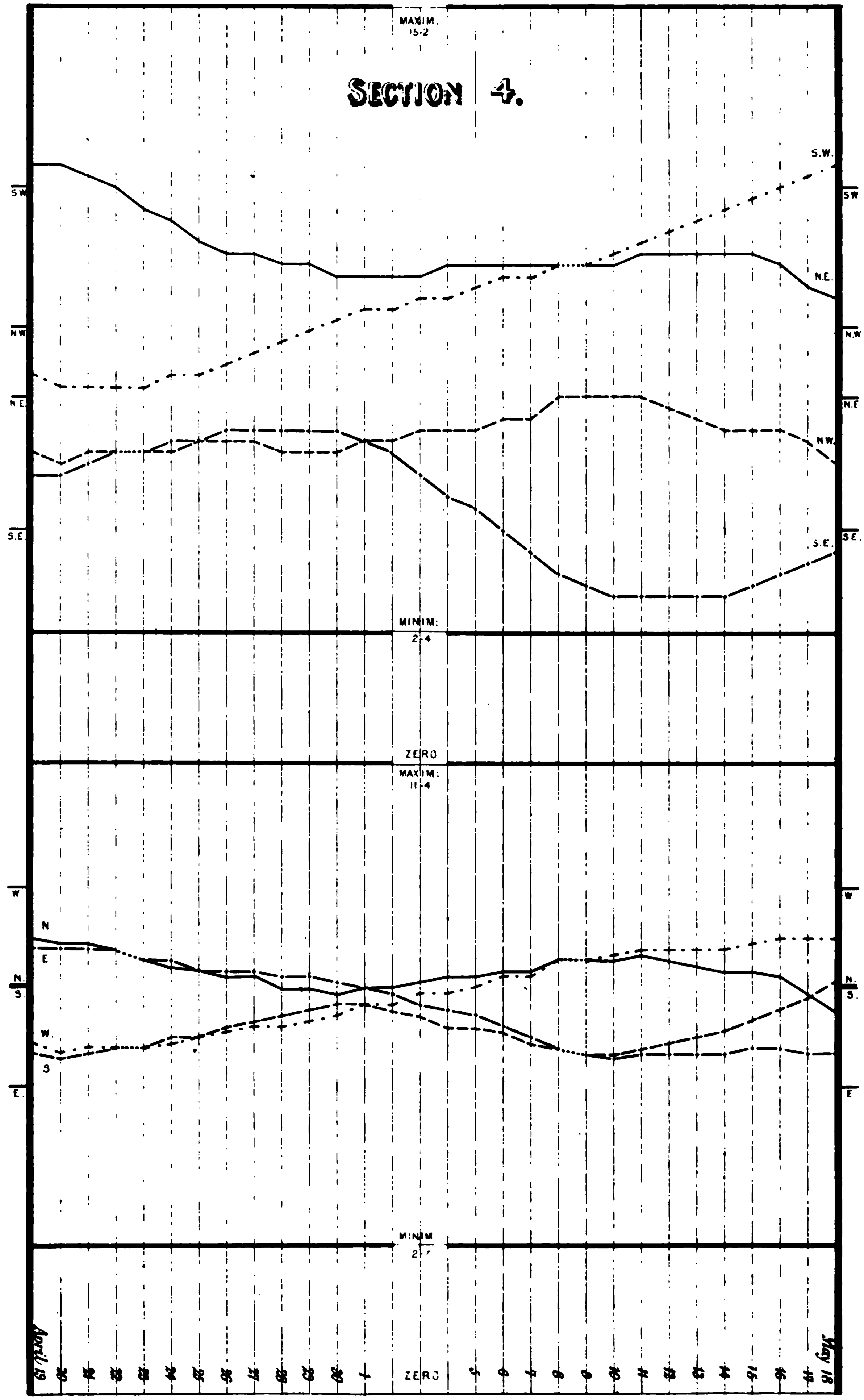


CLOUD.

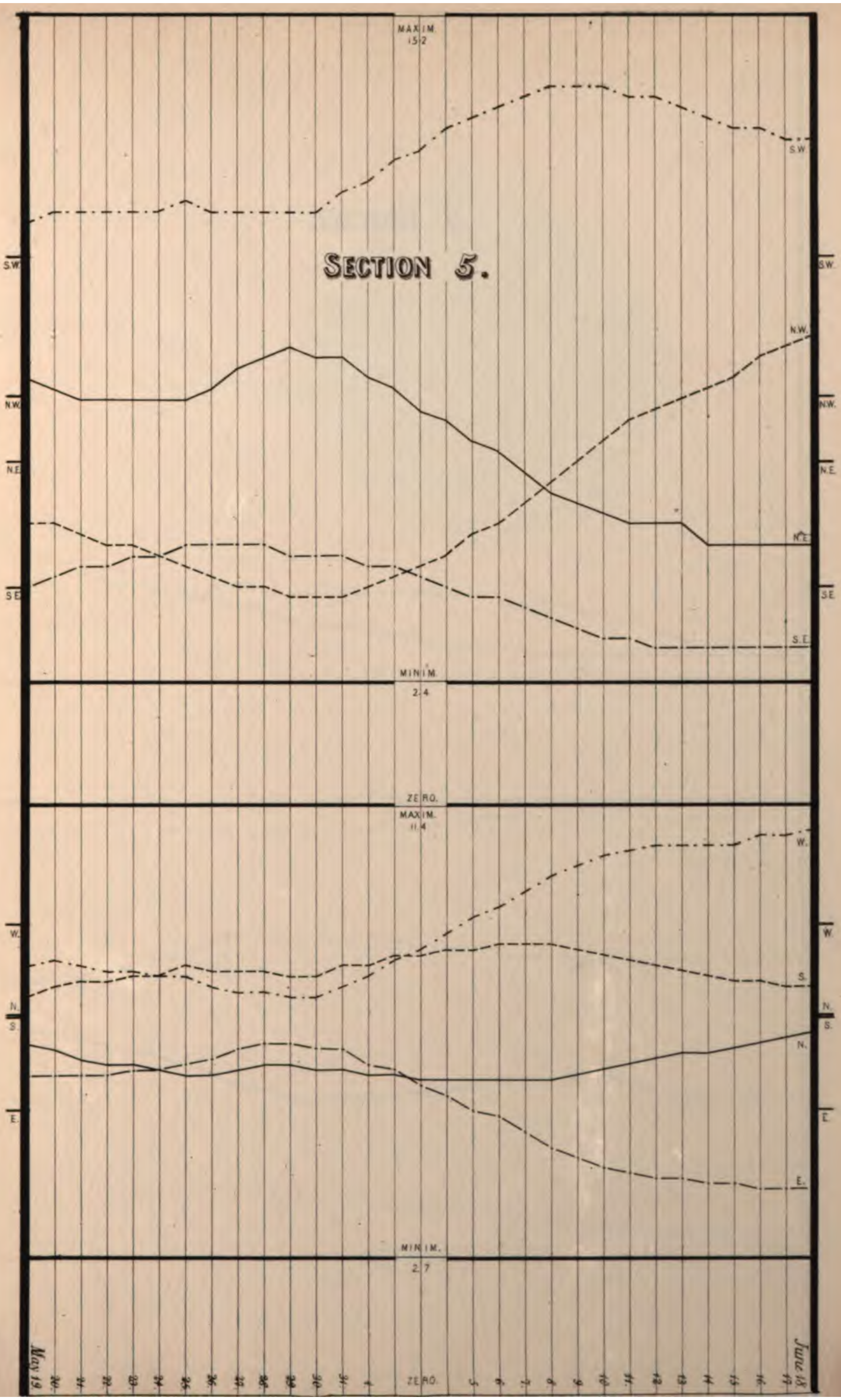
Section 11.

CLOUD.

Section 12.

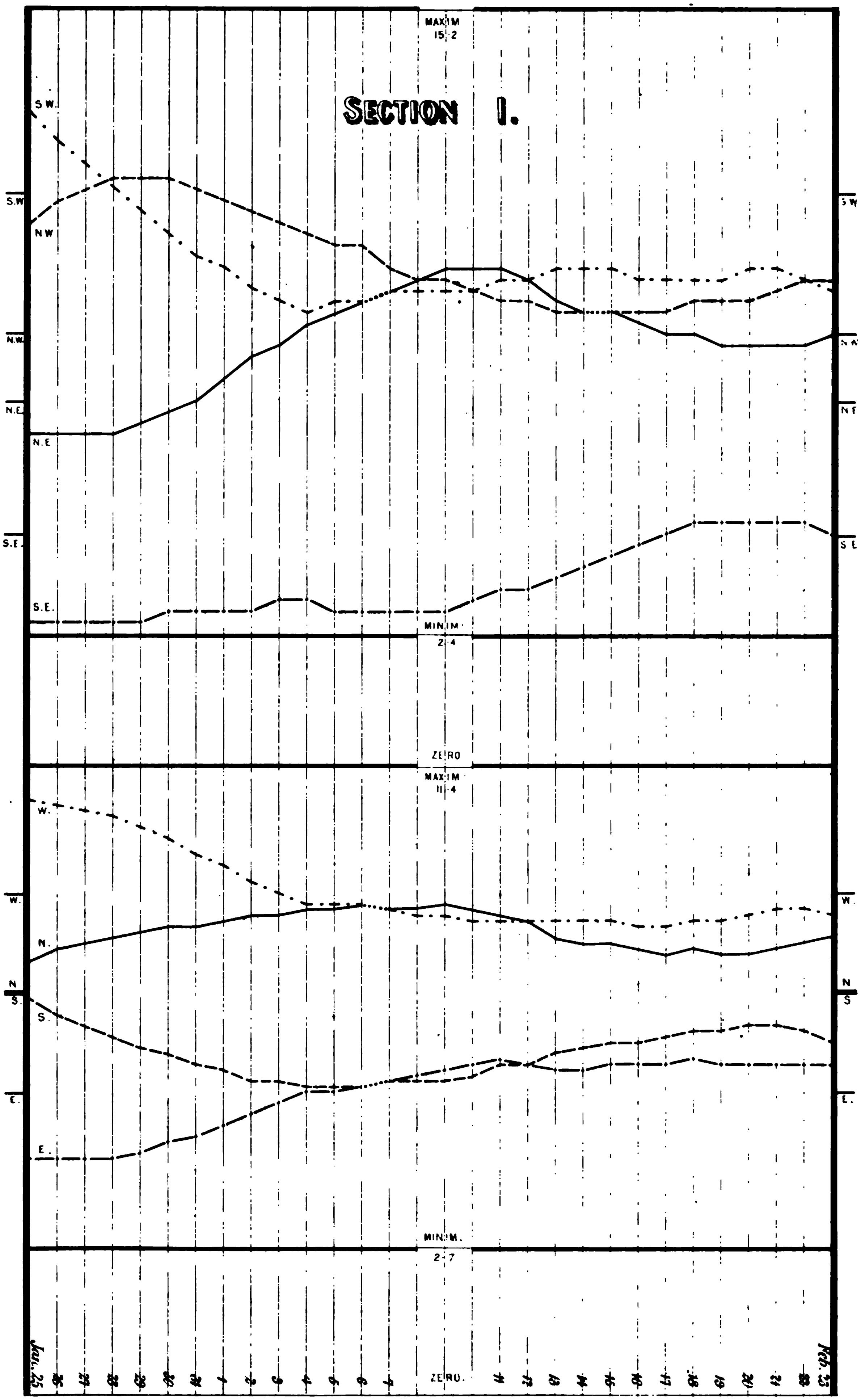

MAXIM.
15·2
SECTION 4.
S.W.
SW
N.E.
NW
NE
N.W.
SE
S.E.
MINIM:
2·4
ZERO
MAXIM:
11·4
W
N
E
N.
S.
W.
S
E
MINIM
2·7
April 19
20
21
22
23
24
25
26
27
28
29
30
1
ZERO
5
6
7
8
9
10
11
12
13
14
15
16
17
May 18

SECTION 5.

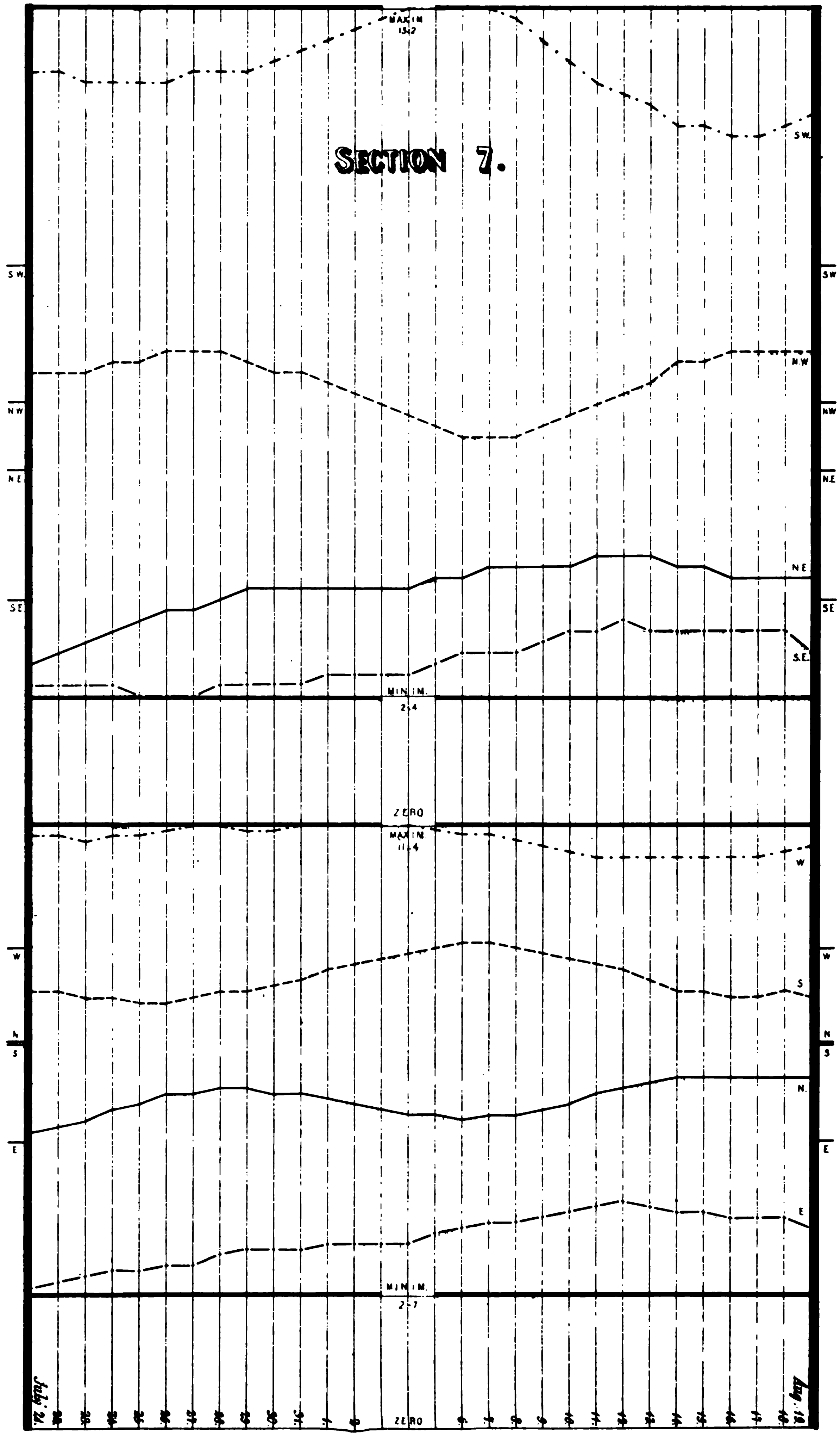

MAXIM.
15.2
S.W.
S.W.
S.W.
N.W.
N.W.
N.W.
N.E.
N.E.
N.E.
S.E.
S.E.
S.E.
MINIM.
2.4
ZERO.
MAXIM.
11.4
W.
W.
W.
S.
N.
S.
N.
S.
N.
E.
E.
E.
MINIM.
2.7
May 19.
20.
21.
22.
23.
24.
25.
26.
27.
28.
29.
30.
31.
1
ZERO.
5
6
7.
8
9.
10.
11.
12.
13.
14.
15.
16.
17.
June 18.

The Diagrams for the direction of the wind are constructed differently from the other diagrams. The compartments for the category of semicircles are altogether distinct from those for the category of quadrants: each compartment is constructed with the values as they are given in Table XXII. The mean annual value for each of the eight winds is given in the margin. Each Section is drawn upon a field representing the *whole annual range* for the respective compartment. The horizontal lines for the degrees of the scale are omitted for the sake of avoiding confusion: the value 0.1 in the Table corresponds to 0.04 of an inch in the diagrams; and consequently, $\frac{4}{10}$ of an inch is equivalent to one day; and the value five days is given by two inches measured from the zero line.

SECTION I.

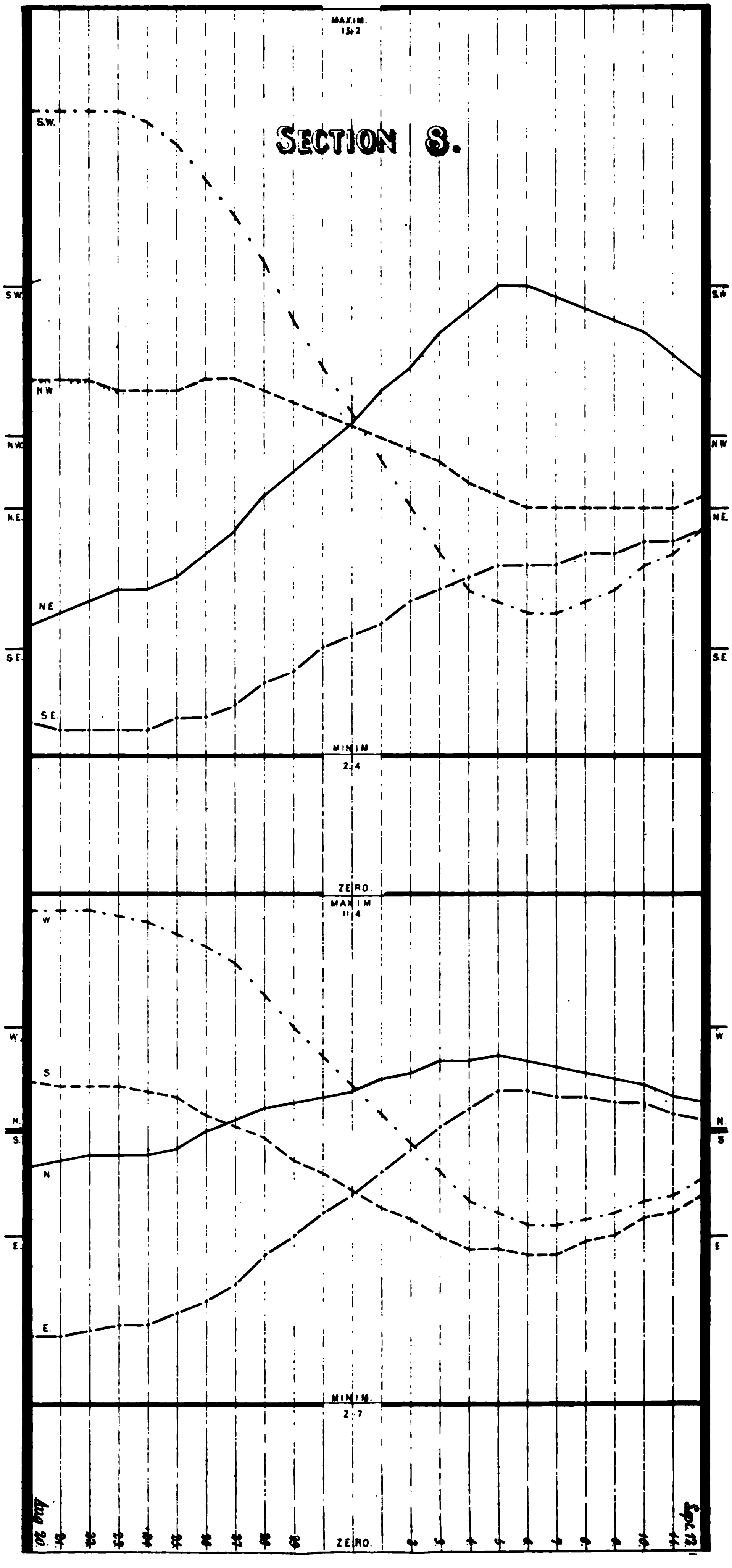

MAXIM
15.2
S.W.
S.W
NW
N.W.
N.E
N.E
S.E.
S.E.
MINIM.
2.4
ZERO
MAXIM
11.4
W.
W.
N.
N
S
S.
E.
E.
MINIM.
2.7
Jan. 25
26
27
28
29
30
31
1
2
3
4
5
6
7
ZERO.
11
12
13
14
15
16
17
18
19
20
21
22
Feb. 23

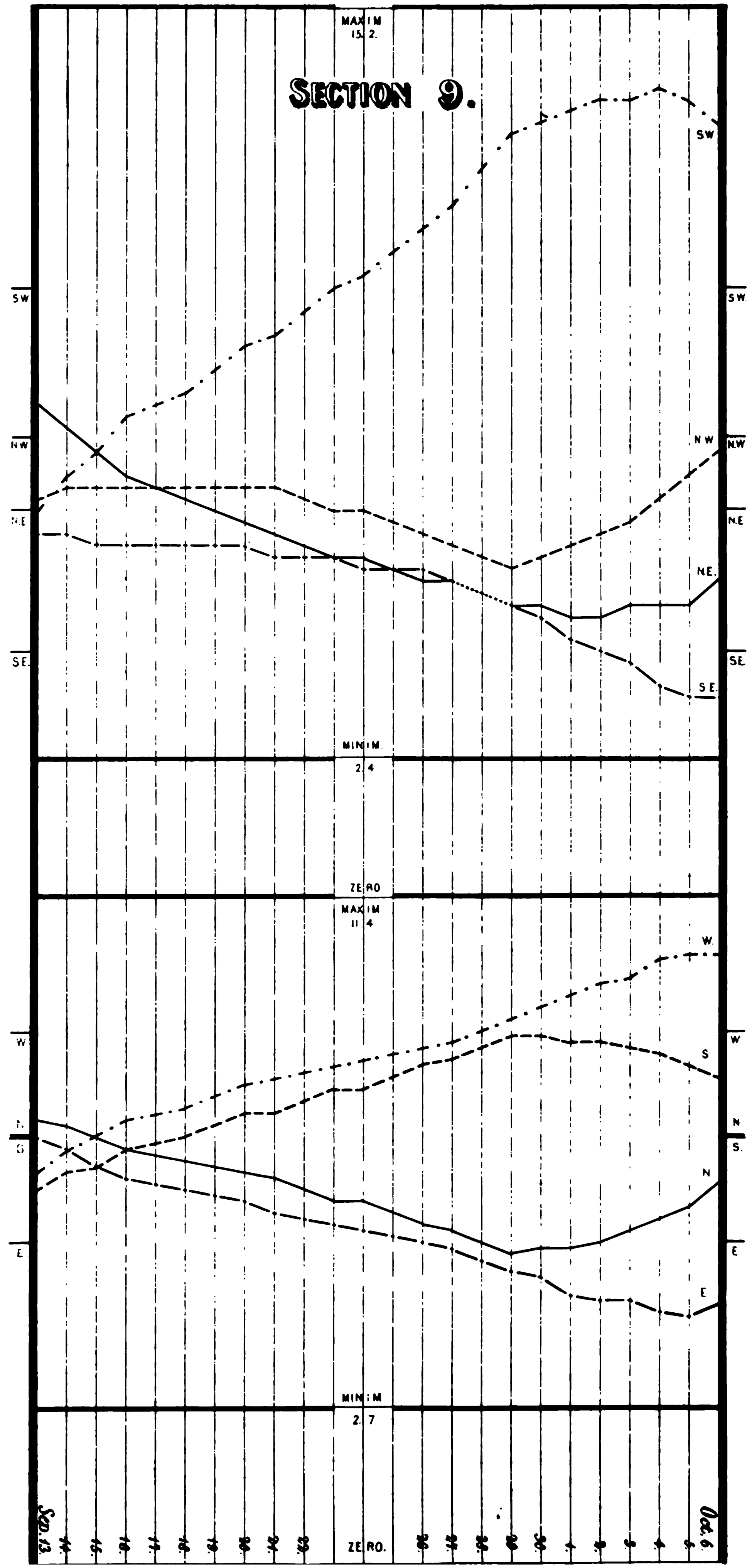
SECTION 7.

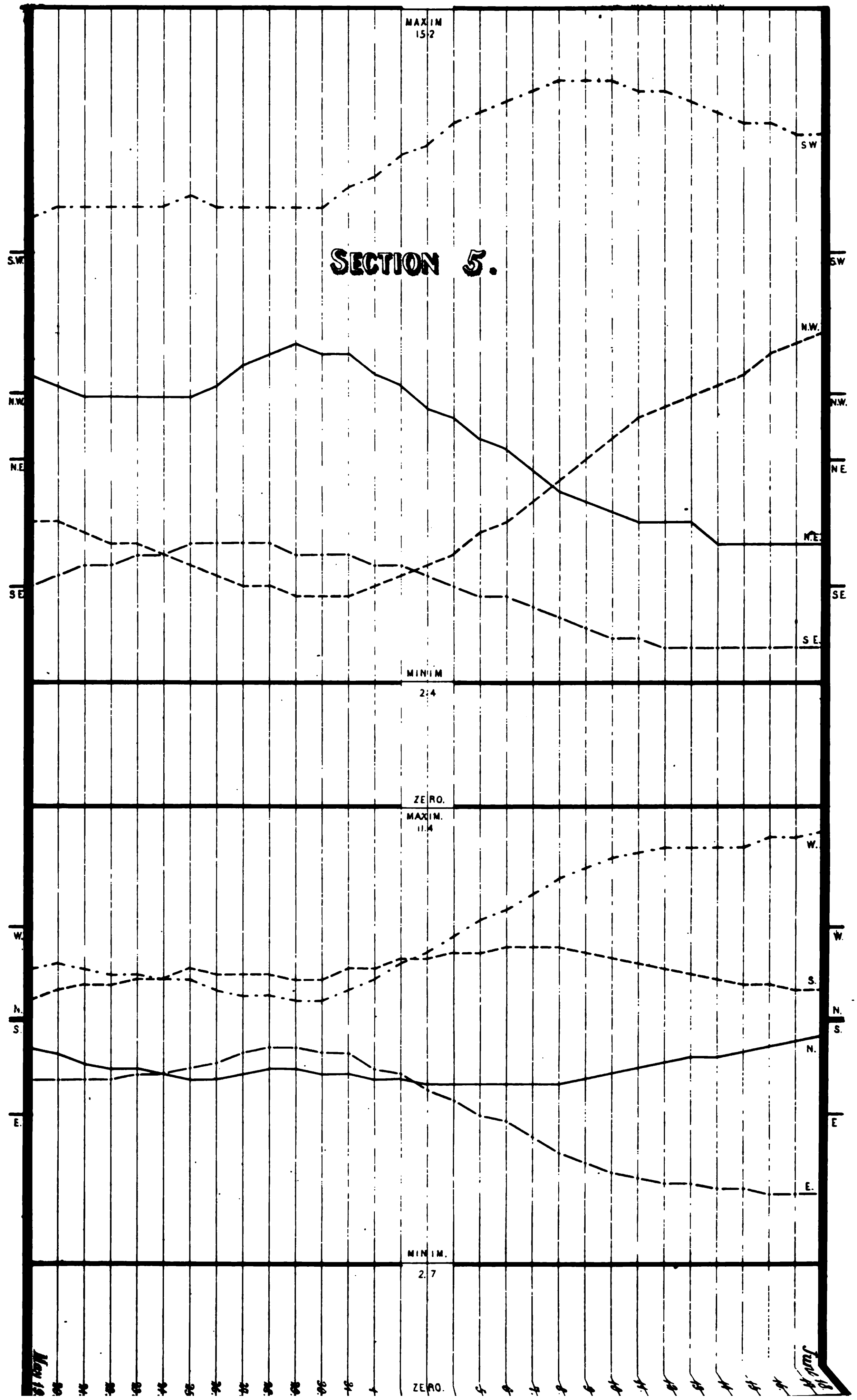


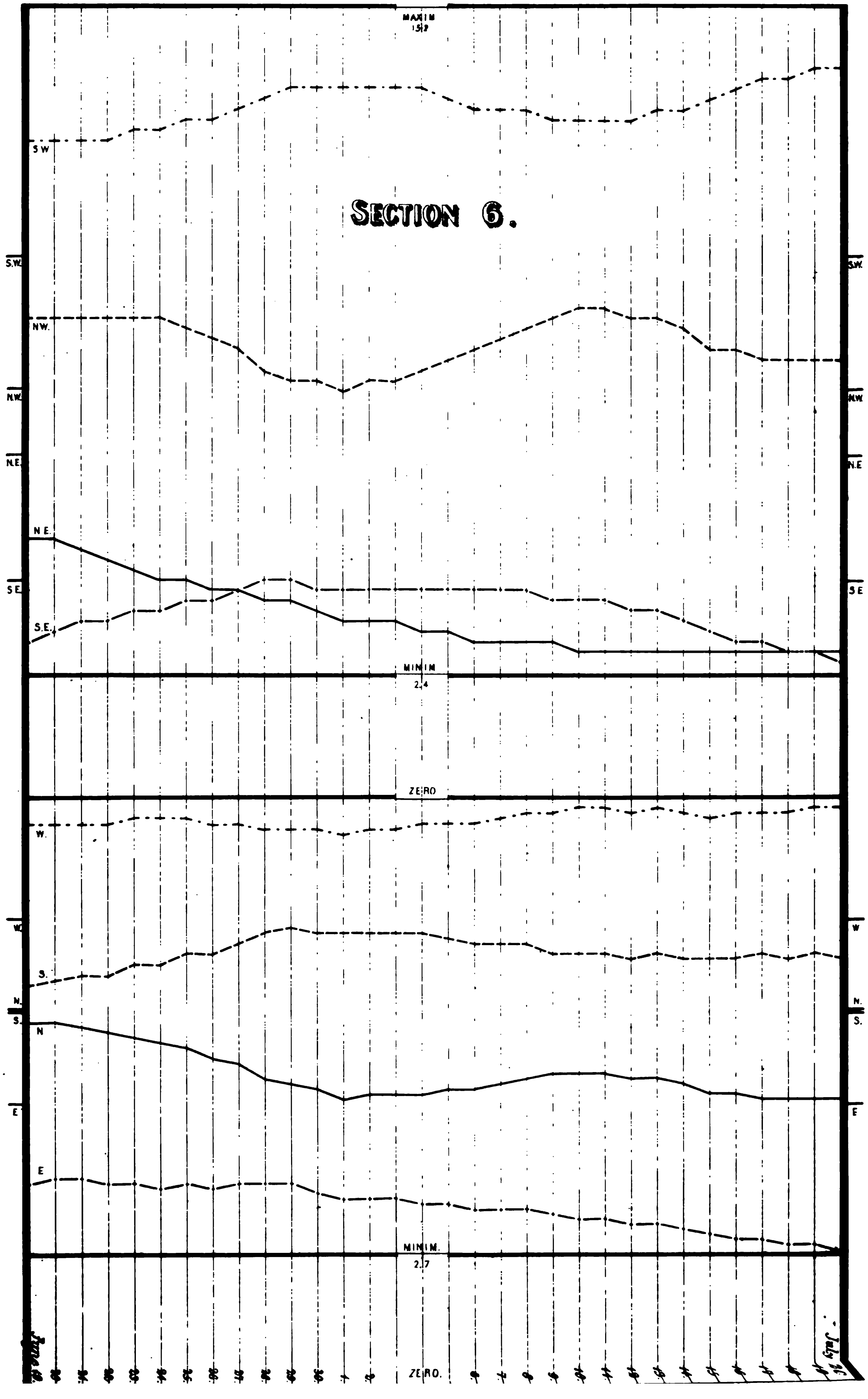
MAXIM 15·2
SW
SW
NW
NW
NE
NE
SE
SE
MINIM 2·4
ZERO
MAXIM 11·4
W
W
S
N
S
N
E
E
MINIM 2·7
July 21.
22.
23.
24.
25.
26.
27.
28.
29.
30.
31.
1.
2.
ZERO
6.
7.
8.
9.
10.
11.
12.
13.
14.
15.
16.
17.
18.
Aug. 19.

SECTION 8.

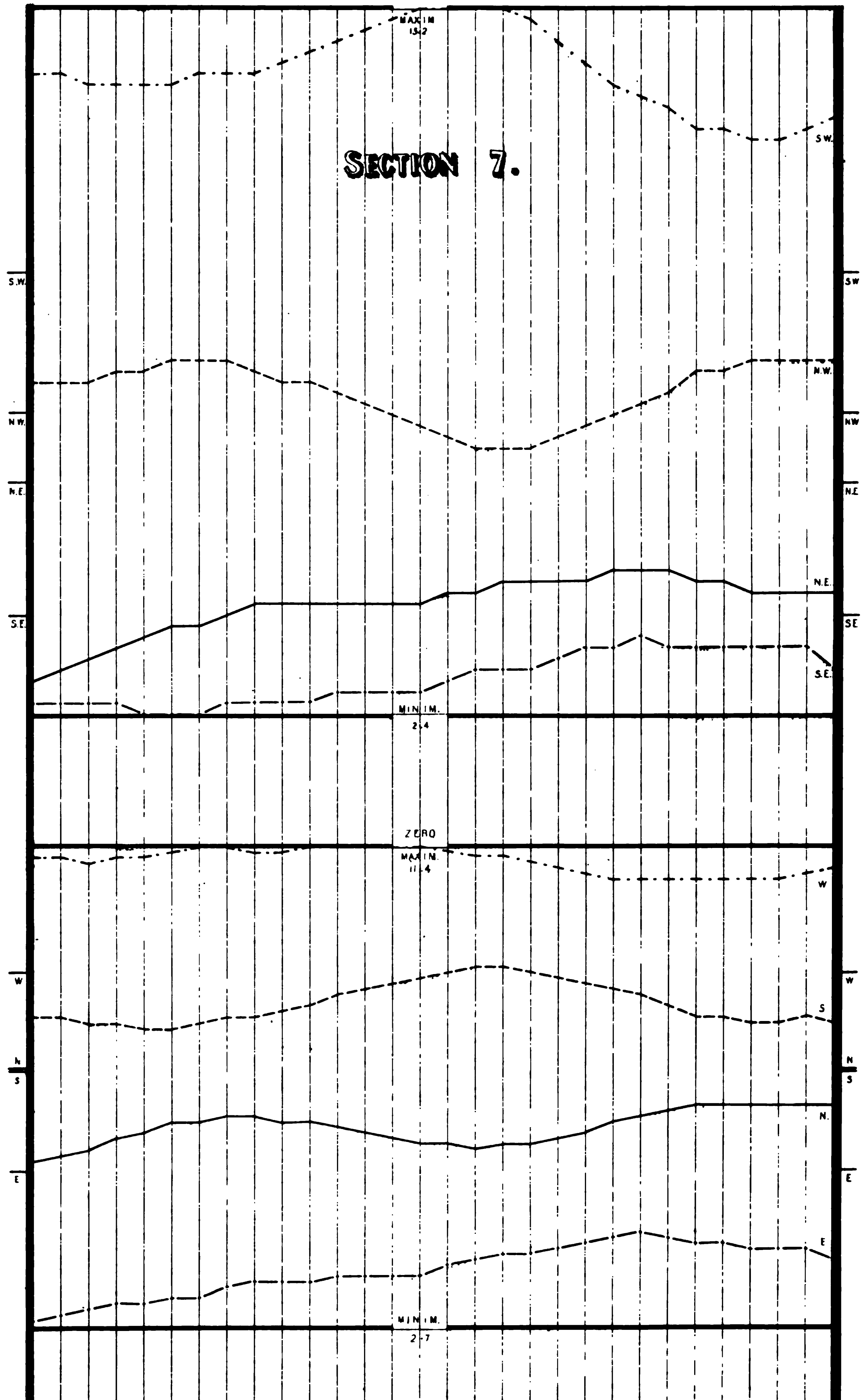

MAXIM.
15.2
S.W.
SW
NW
NW
NE.
NE
SE.
SE
MINIM
2.4
ZERO.
MAXIM
11.4
W
W
S
N.
S.
N
E.
E
MINIM.
2.7
Aug 20.
21
22
23
24
25
26
27
28
29
ZERO.
2
3
4
5
6
7
8
9
10
11
Sept. 12.

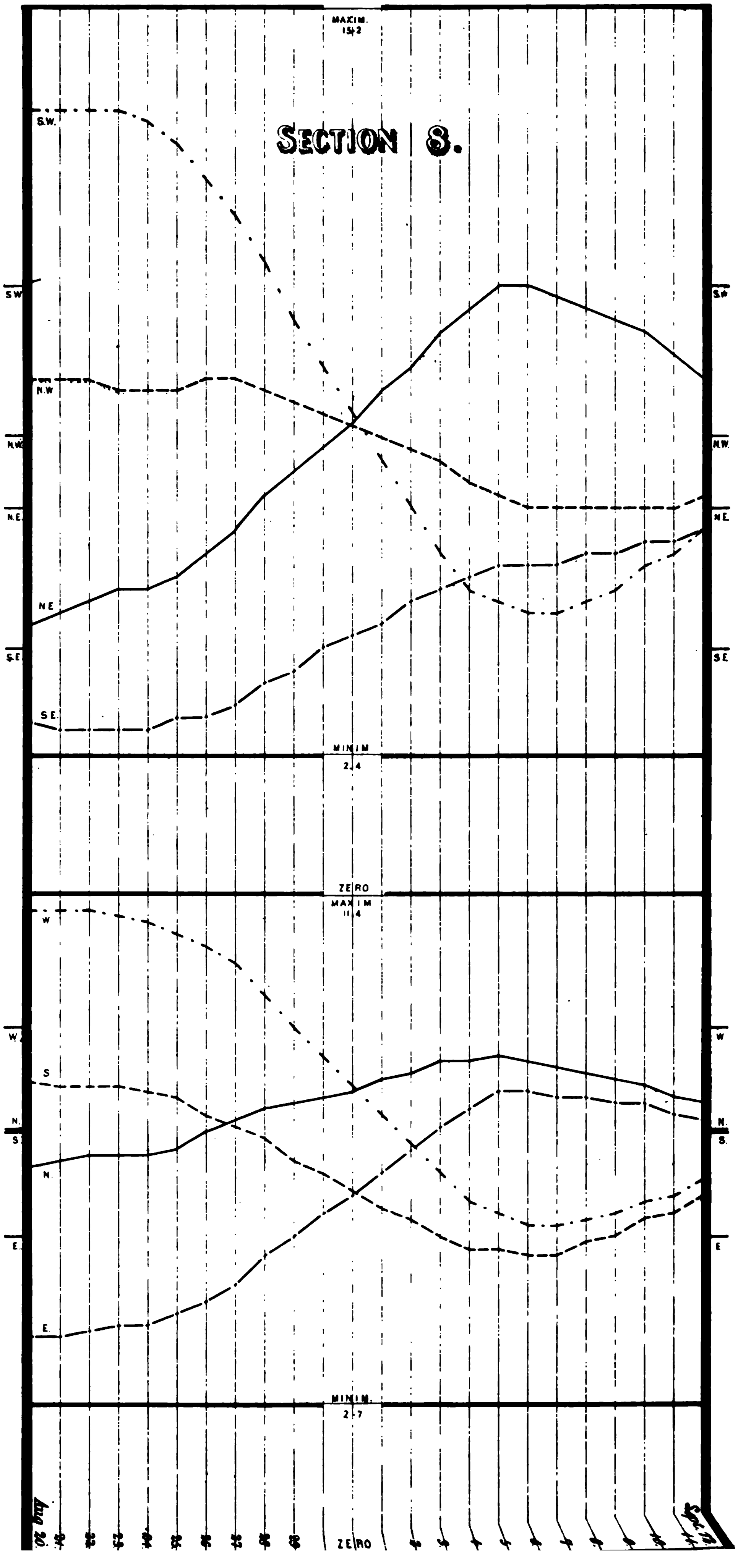

MAXIM
15.2.
SECTION 9.
SW
SW.
SW.
NW
NW
N.W
NE
N.E
NE.
SE.
SE.
S E.
MINIM.
2.4
ZERO
MAXIM
11.4
W.
W
W
S
N.
S.
N
S.
N
E
E
E
MINIM
2.7
Sep. 13.
14.
15.
16.
17.
18.
19.
20.
21.
22.
ZERO.
26.
27.
28.
29.
30.
1.
2.
3.
4.
5.
Oct. 6.

SECTION 5.
MAXIM 15.2
MINIM 2.4
ZERO.
MAXIM. 11.4
MINIM. 2.7
ZERO.
SW
S.W.
N.W.
N.E.
SE
SE.
W.
S.
N.
E.
May 19
20
21
22
23
24
25
26
27
28
29
30
31
1
5
6
7
8
9
10
11
12
13
14
15
16
June 17

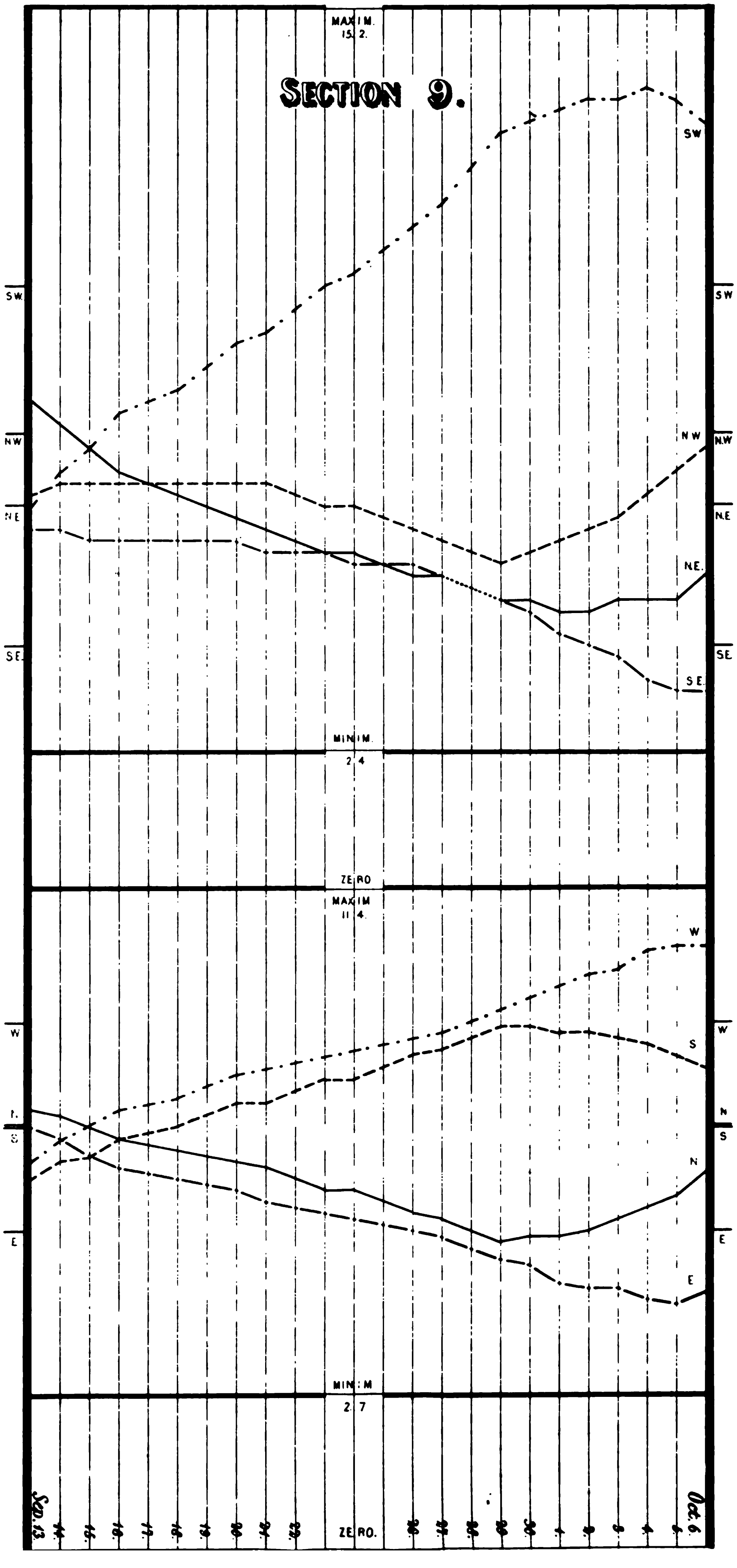

MAXIM
15.2
S W
SECTION 6.
S.W.
NW.
N.W.
N.E.
N E.
S.E.
S.E.
MINIM
2.4
ZERO
W.
W
S.
N.
S.
N
E
E
MINIM.
2.7
June 18.
24.
25.
26.
27.
28.
29.
30.
1.
2.
ZERO.
6.
7.
8.
9.
10.
11.
12.
13.
14.
15.
16.
17.
18.
19.
July 20.

SECTION 7.


MAXIM
13·2
S.W.
S.W.
SW
N.W.
N.W.
NW
N.E.
N.E.
NE
S.E.
S.E.
SE
MINIM.
2·4
ZERO
MAXIM.
11·4
W
W
W
S
N
N
S
S
N.
E
E
E
MINIM.
2·7
July 21.
22.
23.
24.
25.
26.
27.
28.
29.
30.
31.
1.
2.
ZERO
6.
7.
8.
9.
10.
11.
12.
13.
14.
15.
16.
17.
18.
Aug. 19.


MAXIM.
15.2
SECTION 8.
S.W.
SW
N.W
N.W.
NE
N.E.
SE
S.E.
MINIM.
2.4
ZERO
MAXIM.
11.4
W
S
N
E
MINIM.
2.7
Aug 20.
ZERO

SECTION 9.


MAXIM.
15.2.
SW
SW
SW
NW
NW
NW
NE
NE.
NE
SE
SE.
SE
MINIM.
2.4
ZERO
MAXIM.
11.4.
W
W
W
S
N
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Oct. 6.

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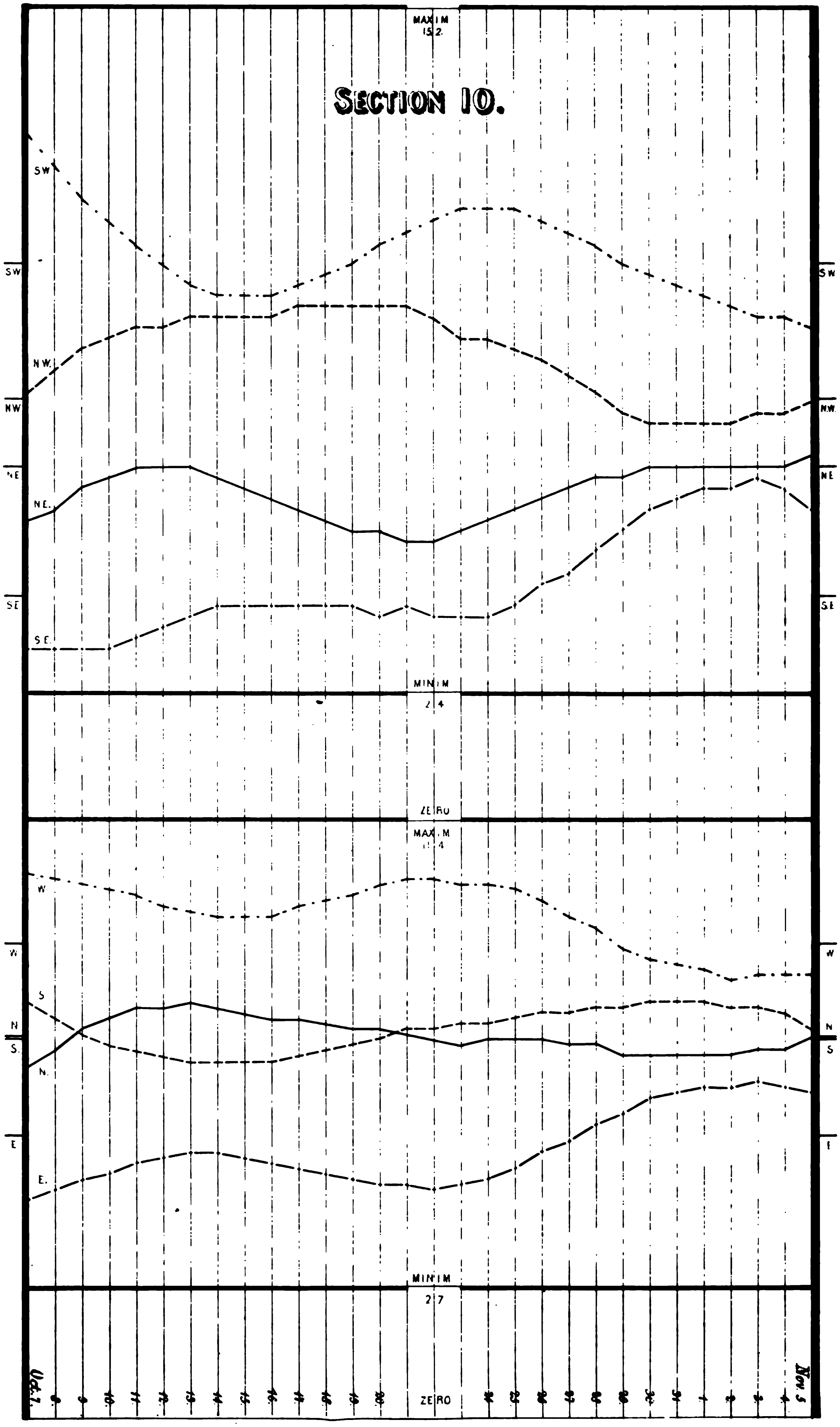
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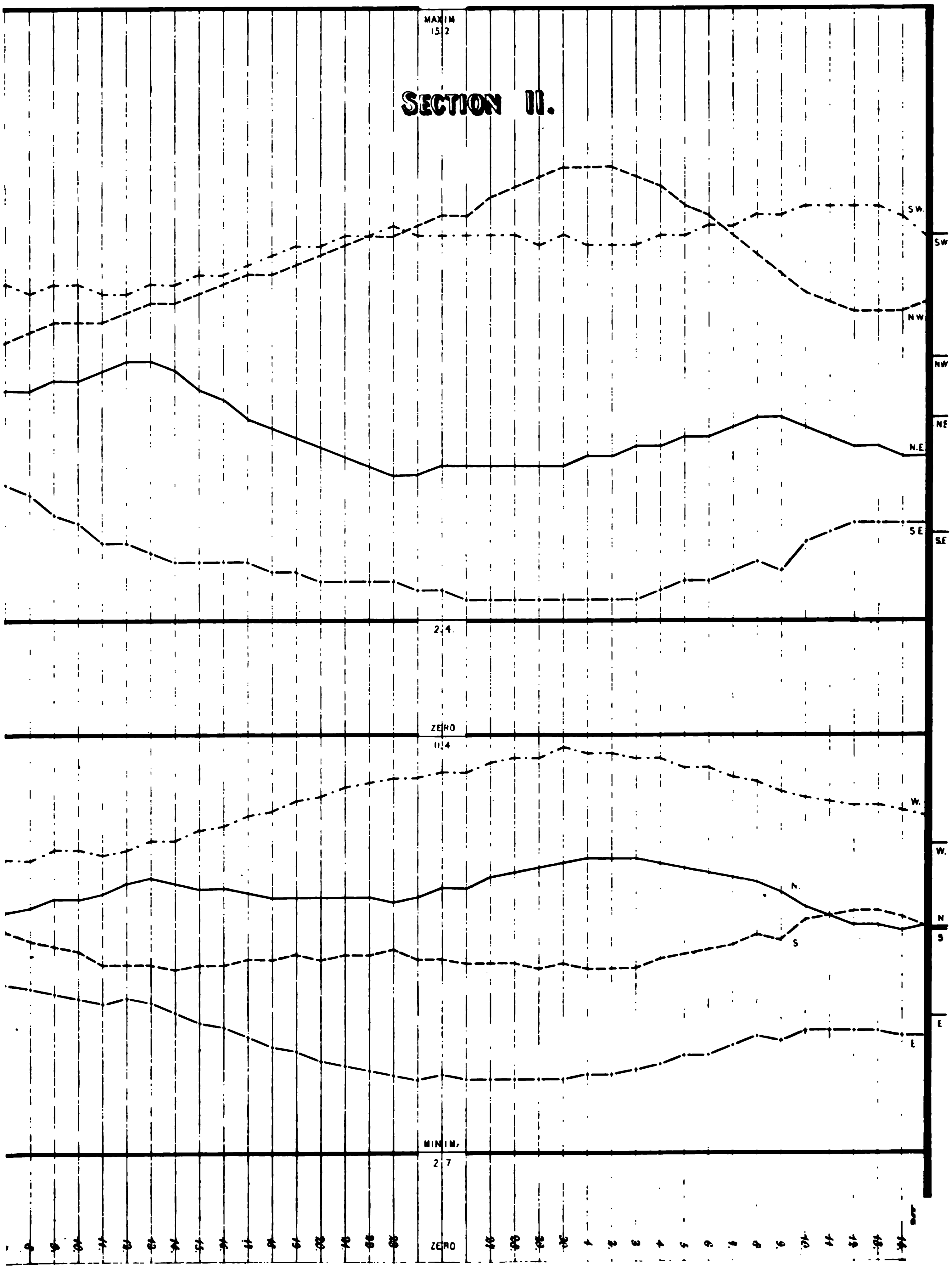
SECTION II.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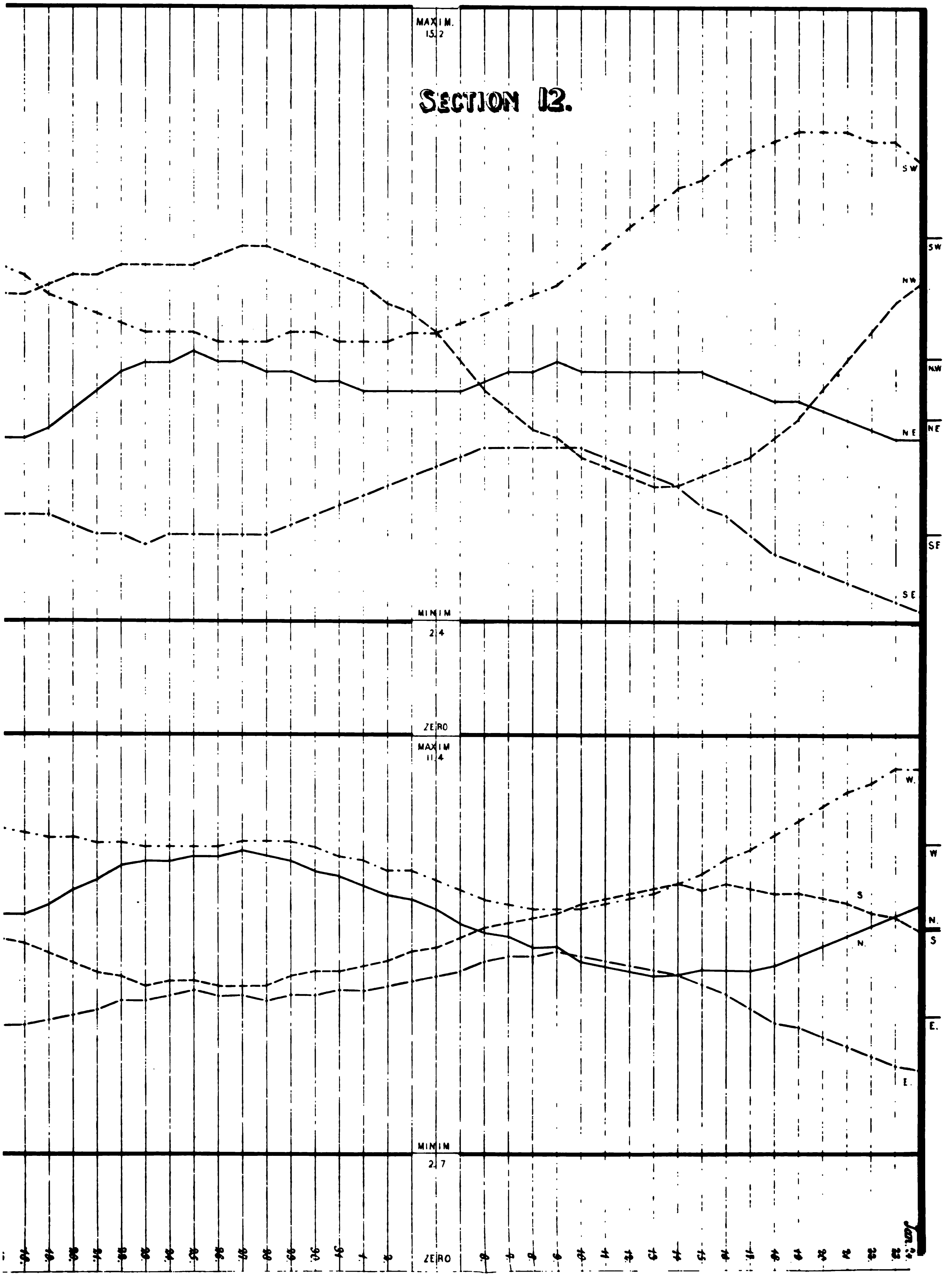
SECTION 12.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APPENDIX.

DIURNAL VARIATION OF ATMOSPHERIC TEMPERATURE.

In investigating the subject of diurnal variation of temperature—as well as in several other respects—I have obtained great assistance from the courtesy and kindness of Mr. Glaisher, who supplied me with the results of the Greenwich observations. I was able to compare the results of observations at Newport made at several hours of the day, during a period of four years, with corresponding values for Greenwich as determined by observations of many years continuance; and thus, to determine the difference there might be in the diurnal progression of temperature at the two sites. I was brought to the conclusion that there was a material difference between the two lines of progression, and that consequently Mr. Glaisher's Tables II. and III. did not afford satisfactory corrections, for all hours, for Newport. It appeared to be clearly the fact that the temperature rose more rapidly at Newport than at Greenwich, at about that period of the day when the mean daily values occur; and that Mr. Glaisher's corrections for 9 a.m., consequently, gave too high a value for the Newport diurnal mean: the means when computed in this way, were materially higher than when computed by the Table VII. for the two extreme readings of the thermometer. It also appeared that the temperature fell again with a corresponding rapidity in the afternoon; and, probably, if two readings had been used,—one bearing the same relation to the afternoon mean that the other did to the forenoon mean—the result would have been perfectly satisfactory; but my afternoon observations had not the requisite correspondence with the 9 a.m. observations to render them available in this way. I felt satisfied, however, that Mr. Glaisher's Table VII. was correct for Newport; and, probably, the diurnal mean temperature bears very much the same relationship to the extremes, in different localities, even when their respective conditions are meteorologically very different.

Newport being surrounded with comparatively high ground, it has not the benefit of the sun's rays until a comparatively late hour in the forenoon; but when these rays do enter the valley they tell upon its temperature with double effect. Although the temperature at 9 a.m. in Newport was found to be much in excess of the Greenwich standard for this period of the day, during a great part of the year, it appeared that in the shortest days it was in defect; and when it is considered that on the longest day the sun has the same elevation at 5h. 42m. in the forenoon (as well as at 6h. 18m. in the afternoon) that he has at noon on the shortest day, this is nothing more than might be expected; because, the rapid heating of the locality does not occur in the short days until noon is approaching.

I was enabled by a friend, Mr. Clarke, to compare the Newport observations with his made on the hill at Staplers, in the neighbourhood of Newport, during a period of fifteen months; and the collation of the daily values gave the clearest confirmation to the law deduced from the Greenwich comparison: thus, whilst the temperature at 8h. 15m. forenoon was for the year 0°.85 below the mean of the extremes, at Newport; it was 2°.1 below at Staplers,—making a difference of 1°.25 for the two localities; and whilst for the three months July, August, September, the value for 8¼ was 0°.8 in excess, at Newport, it was 1°.74 in defect at Staplers, —making a difference of 2°.24: on one occasion, early in July, the temperature at 8¼ was 9°.8 higher in Newport than at Staplers,—the sun's rays acting then powerfully—although the mean diurnal value was the highest at Staplers by 1°.2 on that same day.

The point may be further illustrated by looking to the effect of sunshine: if the values for 8¼ in August be ranged in two categories; *viz.*, one for cloud, and one for sunshine; it is then found that the former category gives an excess for Newport of 1°, and the latter of 4°.6.

An enclosed valley has a lower minimum temperature, and a higher maximum temperature, than an isolated hill has; and this is more especially the case when there is a clear sky. In the valley the full effect of radiation is felt at night; and the full effect of the sun's heating power is felt in the day; and the temperature of the atmosphere at four feet from the surface is controlled by that of the earth: but on the isolated hill top, although radiation is active from the surface of the earth, the atmosphere four feet above it partakes of the temperature of the surrounding atmosphere, and even controls the temperature to some extent of the earth; so, too, in the day, the sun's heating influence on the earth is counteracted by the temperature of the atmosphere: the atmosphere being less affected by radiation, and by the sun's rays, than the earth is; and, consequently, it varies less in temperature through the 24 hours; so,—the hill top atmospheric temperature varies less than that of the valley. The minimum temperature is—taking the whole year—0°.5 lower at Newport than at Staplers; the maximum is 0°.6 higher; and at 9 a.m. it is 1°.6 higher.

Under these circumstances, I have trusted to the daily means of the extreme readings—corrected by Mr. Glaisher's Table VII.—for my diurnal mean values: but the amounts, as given in this Table for the months, were reduced to their proportionate values for each day, and these daily values are given in Table A.

TABLE A.

Daily corrections for diurnal variation of Atmospheric Temperature.
To be applied substractively to the mean values of the two daily extremes.

	Jan.	Feb.	March.	April.	May.	June.	July.	August	Sept.	Oct.	Nov.	Dec.
1	0°.08	0°.28	0°.67	1°.24	1°.59	1°.78	1°.86	1°.80	1°.53	1°.16	0°.69	0°.20
2	0.09	0.29	0.69	1.26	1.60	1.75	1.86	1.79	1.51	1.15	0.67	0.18
3	0.09	0.30	0.71	1.28	1.61	1.76	1.87	1.79	1.50	1.14	0.65	0.16
4	0.10	0.30	0.73	1.30	1.61	1.76	1.87	1.78	1.49	1.13	0.63	0.15
5	0.11	0.31	0.75	1.31	1.62	1.76	1.87	1.77	1.47	1.12	0.61	0.13
6	0.11	0.32	0.77	1.33	1.63	1.77	1.88	1.77	1.46	1.11	0.60	0.12
7	0.12	0.33	0.79	1.34	1.63	1.77	1.88	1.76	1.45	1.10	0.58	0.11
8	0.12	0.34	0.81	1.36	1.64	1.77	1.89	1.76	1.43	1.09	0.56	0.10
9	0.12	0.34	0.83	1.38	1.65	1.78	1.89	1.75	1.42	1.08	0.54	0.08
10	0.13	0.35	0.86	1.39	1.65	1.78	1.89	1.75	1.41	1.07	0.52	0.07
11	0.14	0.36	0.88	1.41	1.66	1.78	1.90	1.74	1.39	1.06	0.50	0.06
12	0.14	0.37	0.90	1.42	1.67	1.79	1.90	1.74	1.38	1.04	0.48	0.04
13	0.15	0.38	0.92	1.44	1.67	1.79	1.90	1.73	1.37	1.03	0.46	0.03
14	0.15	0.38	0.94	1.45	1.68	1.79	1.89	1.73	1.35	1.02	0.44	0.01
15	0.16	0.39	0.96	1.47	1.69	1.80	1.89	1.72	1.34	1.01	0.42	0.00
16	0.16	0.40	0.98	1.49	1.69	1.80	1.88	1.72	1.33	1.00	0.40	0.00
17	0.17	0.42	1.00	1.50	1.70	1.80	1.87	1.71	1.31	0.98	0.39	0.00
18	0.18	0.44	1.02	1.51	1.70	1.81	1.87	1.71	1.30	0.96	0.38	0.00
19	0.18	0.46	1.03	1.52	1.71	1.81	1.86	1.70	1.29	0.94	0.36	0.00
20	0.19	0.48	1.05	1.53	1.71	1.82	1.86	1.69	1.28	0.92	0.35	0.01
21	0.19	0.50	1.06	1.53	1.71	1.82	1.85	1.67	1.27	0.91	0.34	0.01
22	0.20	0.52	1.08	1.54	1.72	1.82	1.85	1.66	1.26	0.89	0.32	0.01
23	0.21	0.54	1.10	1.55	1.72	1.83	1.84	1.65	1.25	0.87	0.31	0.01
24	0.22	0.57	1.11	1.56	1.72	1.83	1.84	1.63	1.24	0.85	0.30	0.01
25	0.22	0.59	1.13	1.56	1.73	1.84	1.83	1.62	1.23	0.83	0.29	0.02
26	0.23	0.61	1.15	1.57	1.73	1.84	1.83	1.61	1.22	0.81	0.27	0.02
27	0.24	0.63	1.16	1.58	1.73	1.84	1.82	1.59	1.21	0.79	0.26	0.03
28	0.25	0.65	1.18	1.58	1.74	1.85	1.82	1.58	1.19	0.77	0.25	0.04
29	0.26		1.19	1.59	1.74	1.85	1.81	1.57	1.18	0.75	0.23	0.05
30	0.26		1.21	1.59	1.74	1.85	1.81	1.55	1.17	0.73	0.22	0.06
31	0.27		1.23		1.75		1.80	1.54		0.71		0.07

DIURNAL VARIATION OF DEW-POINT TEMPERATURE.

The diurnal variation for the dew-point is influenced by a greater complication of causes than that for the atmospheric temperature is, but it conforms in some degree to the same law: the advent of the sun's rays has an immediate effect in raising the temperature of the dew-point, but it also has the effect, subsequently, of dispersing the vapour which had deposited itself on the surface of the earth during the night, and accumulated in the atmosphere just above its surface in the course of the early morning; and in consequence of this, the *abnormal* elevation which occurs both in the atmospheric and in the dew-point temperature, in the early part of the day, assumes a greater range for the hour of max. excess, according to the period of the year, in the latter, than in the former particular: the dew-point, again, is more affected by accidental contingencies, than is the atmospheric temperature;—such as, the amount of moisture there may be in the superficial layer of the earth, the quantity of dew deposited on the surface in the preceding night, and the degree of movement there may be in the atmosphere to disperse the vapour.

The annual mean value for the dew-point as deduced by Mr. Glaisher's Table from 9 a.m. observations, is 0°.8 higher than that deduced from observations at noon; and the difference amounts to 1°.7 for the three months March, September, October. In the longest days it is an earlier hour than 9 that gives the maximum of excess to the values: in the shortest days this maximum does not occur till a later hour than 9, and the noon values then give somewhat the higher *mean* of the two. The data that I had for a guide seemed to be sufficient for the purpose of modifying, in some degree, Mr. Glaisher's Table, so as to get a correct Table of corrections for Newport; and at any rate there could be no doubt that *greater* accuracy was obtained by the modification. The monthly values having been first determined for the hour 9 a.m., as given below, these values were then reduced to their proportionate *daily* quantities, for use, as exhibited in Table B.

January	1.0	July	1.3
February	1.1	August	2.0
March	1.8	September	2.3
April	1.6	October	2.1
May	1.5	November	1.3
June	1.6	December	0.9

Facts possessed of some interest in this subject, also, may be collected from the comparison of the Newport and Staplers results. The annual mean value for the dew-point, at 9 a.m., is 0°.4 lower in Newport than at Staplers. There are three months characterised by the great defect they show in the 9 o'clock dew-point at Newport, as compared with Staplers, and there are five months characterised by excess or equality: the months for the category of defect are June, July, August;—those for excess are March, April, May, October, November. The category for defect gives the mean value – 1°.57: the category for excess gives the mean value + 0°.18: the effect of sunshine, in respect of these categories, is that of augmenting their respective values;—the value for defect becoming 2°.03 under the influence of sunshine, and that for excess becoming 0°.43. During the months included in the category for defect, the sun's rays had, at 9 o'clock, dispersed the vapour which they had previously drawn from the surface of the earth in the valley; and had perhaps transferred it to the higher level,—having been carried there by the movement of the heated air; but during the months included in the category for excess, the sun's rays at 9 o'clock were accumulating vapour in the valley.

The dew-point, for the purpose of these comparisons, was deduced from the readings of the wet and dry bulb thermometers, at Newport, at Greenwich, and at Staplers.

TABLE B.

Daily corrections for diurnal variation of Dew-point Temperature.
To be applied substractively to the values for 9 a.m.

	Jan.	Feb.	March.	April.	May.	June.	July.	August	Sept.	Oct.	Nov.	Dec.
1	0°.77	1°.05	1°.42	1°.73	1°.50	1°.52	1°.46	1°.48	2°.38	2°.19	1°.99	1°.10
2	0.81	1.05	1.49	1.72	1.50	1.54	1.43	1.51	2.38	2.18	1.95	1.09
3	0.86	1.05	1.56	1.71	1.50	1.55	1.41	1.54	2.38	2.17	1.90	1.08
4	0.92	1.05	1.62	1.70	1.50	1.56	1.39	1.58	2.37	2.16	1.84	1.07
5	0.98	1.06	1.69	1.69	1.50	1.57	1.37	1.61	2.37	2.15	1.77	1.06
6	1.00	1.06	1.76	1.68	1.50	1.58	1.34	1.65	2.37	2.14	1.69	1.05
7	1.00	1.06	1.83	1.67	1.50	1.59	1.32	1.70	2.37	2.13	1.60	1.04
8	1.00	1.06	1.90	1.66	1.50	1.60	1.30	1.74	2.36	2.12	1.50	1.03
9	1.00	1.06	1.94	1.65	1.50	1.61	1.28	1.79	2.36	2.11	1.40	1.02
10	1.00	1.06	1.94	1.64	1.50	1.62	1.26	1.83	2.36	2.10	1.32	1.01
11	1.00	1.07	1.94	1.63	1.50	1.63	1.24	1.87	2.36	2.10	1.25	1.00
12	1.00	1.07	1.93	1.62	1.50	1.64	1.22	1.91	2.35	2.10	1.19	0.99
13	1.00	1.07	1.93	1.61	1.50	1.65	1.20	1.95	2.34	2.10	1.14	0.97
14	1.00	1.08	1.92	1.60	1.50	1.66	1.18	1.99	2.33	2.10	1.11	0.95
15	1.00	1.08	1.92	1.59	1.50	1.67	1.16	2.03	2.32	2.10	1.10	0.93
16	1.00	1.09	1.91	1.58	1.50	1.68	1.17	2.06	2.31	2.09	1.10	0.91
17	1.01	1.09	1.91	1.57	1.50	1.67	1.18	2.09	2.30	2.09	1.10	0.89
18	1.01	1.10	1.90	1.57	1.50	1.66	1.19	2.12	2.29	2.09	1.10	0.87
19	1.02	1.11	1.90	1.56	1.50	1.65	1.21	2.15	2.28	2.09	1.10	0.85
20	1.02	1.12	1.89	1.56	1.50	1.63	1.23	2.17	2.26	2.09	1.10	0.83
21	1.03	1.13	1.89	1.56	1.50	1.62	1.25	2.19	2.25	2.09	1.10	0.81
22	1.03	1.15	1.88	1.55	1.50	1.61	1.26	2.21	2.24	2.08	1.10	0.79
23	1.03	1.17	1.88	1.55	1.50	1.59	1.28	2.23	2.23	2.08	1.10	0.77
24	1.04	1.20	1.87	1.54	1.50	1.58	1.30	2.25	2.22	2.08	1.10	0.75
25	1.04	1.23	1.87	1.54	1.50	1.57	1.32	2.27	2.22	2.07	1.10	0.73
26	1.04	1.24	1.86	1.52	1.50	1.56	1.34	2.29	2.21	2.07	1.10	0.73
27	1.05	1.29	1.85	1.52	1.50	1.55	1.36	2.31	2.21	2.06	1.10	0.73
28	1.05	1.35	1.83	1.50	1.50	1.53	1.38	2.33	2.20	2.06	1.10	0.73
29	1.05		1.81	1.50	1.50	1.52	1.40	2.35	2.20	2.05	1.10	0.73
30	1.05		1.78	1.50	1.50	1.50	1.42	2.37	2.19	2.04	1.10	0.74
31	1.05		1.75		1.50		1.45	2.39		2.02		0.75

ARCTIC CLIMATE.

My attention having been directed to the meteorological Tables in Sir John Ross's narrative of his second Arctic expedition, these were subjected to careful examination and analysis, as well as compared with the meteorological history given for Newport. The particulars elicited seemed to be interesting in reference to the general subject of meteorology, as well as in reference to the statistics and views advanced in the pages of this work: they appear to give strong confirmation to the views there taken. Sir John Ross's position was, virtually, that of the magnetic pole,—being in the same latitude; but his position was on the east coast of Boothia Felix, whilst the magnetic pole is on the west coast. The magnetic pole varies in its situation, but this is unimportant at present as it was in the midst of the sixteen years of Newport observation that the site of the magnetic pole was ascertained by Sir James C. (then Commander) Ross. Sir John Ross's observations were carried on during three winters and two summers, and were recorded hourly, and the mean values of the hourly observations for temperature are given in his Tables, for each day: in order to render these daily values available for the intended purpose, all those belonging to the same date of the year were combined together; and these combined mean values were then further reduced to average values by the two-fold decadal reduction: the same process was adopted with the values given for deposition; but the values for this particular are notified by the number of hours of deposition—not by the *quantity* deposited.

Table C on page 141 gives the values for temperature for each day in the year computed and reduced in the manner described above.

The mean temperature for the year,—*i.e.* the mean of the 365 daily values,—is 4°.00. The range for the year is 81°.6 (the correlative value for Newport being 22°.7. The maximum mean value is 43°.8 (Newport 61°.4): the minimum is − 37°.8 (Newport 38°.7). There are 159 days of rising temperature (Newport 173),—giving a mean daily rate 0°.51 (Newport 0°.13): there are 206 days of declining temperature (Newport 192),—giving a mean daily rate 0°.40 (Newport 0°.12). There are 167 days below the mean (Newport 194): there are 196 above the mean (Newport 169). The annual mean temperature being 4°.00, the mean of the two extreme diurnal values is 2°.02: the difference between these two varieties of means at Newport is only 0°.63, but the difference obtains in the opposite direction; a diversity which corresponds with that shown for the number of days above, and the number below mean temperature. The entire range at Newport between the lowest minimum recorded during the sixteen years and the highest maximum is 77°.6.

TABLE C.

Daily values of atmospheric temperature for the Magnetic pole.
Site of observation, Victoria Harbour, etc.—lat. 70° N. long. 91° 34′ W.

	JAN.	FEB.	MARCH.	APRIL.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.
1	−31.2	−23.4	−34.0	−9.0	+ 2.4	+26.1	+38.5	+42.1	+32.8	+16.7	+ 2.3	−19.6
2	31.8	24.3	34.4	7.8	3.7	26.8	38.6	42.0	32.2	16.4	2.3	19.2
3	32.2	25.5	34.7	6.8	5.0	27.4	38.7	41.8	31.6	16.0	2.3	18.6
4	32.4	27.0	34.8	6.0	6.1	28.0	38.9	41.5	31.1	15.6	**2.4**	18.1
5	32.4	28.6	34.9	5.2	7.1	28.7	39.0	41.2	30.5	15.2	2.3	17.9
6	32.3	30.2	34.7	4.5	8.0	29.4	39.2	40.8	30.1	14.8	2.0	**17.8**
7	32.1	31.8	34.3	4.0	8.9	30.1	39.4	40.4	29.7	14.4	1.6	17.9
8	31.7	33.3	33.9	3.6	9.7	30.8	39.5	40.0	29.4	14.0	1.1	18.1
9	31.0	34.7	33.5	3.4	10.5	31.5	39.5	39.6	29.2	13.6	0.5	18.5
10	30.0	36.0	33.1	3.0	11.3	32.1	39.7	39.2	28.9	13.2	−0.2	19.0
11	28.8	36.9	32.8	2.5	12.0	32.7	39.9	38.9	28.6	12.9	0.9	19.6
12	27.7	37.5	32.6	2.0	12.7	33.3	40.1	38.6	28.4	12.6	1.5	20.3
13	26.7	37.8	32.4	1.7	13.5	33.9	40.5	38.4	28.1	12.3	2.2	21.1
14	25.9	37.6	32.2	0.9	14.2	34.5	40.9	38.3	27.8	12.0	3.1	21.7
15	25.1	37.1	31.9	0.7	15.0	35.1	41.4	38.2	27.4	11.6	4.0	22.1
16	24.3	36.3	31.7	0.6	15.8	35.7	41.7	38.1	27.0	11.1	4.8	22.4
17	23.6	35.4	31.4	**0.5**	16.5	36.2	42.3	38.1	26.4	10.4	5.5	22.8
18	23.1	34.5	31.0	0.6	17.3	36.6	42.8	38.1	25.7	9.6	6.4	23.1
19	22.8	33.6	30.4	0.6	17.9	37.1	43.2	38.1	24.8	8.6	7.4	23.4
20	22.9	32.8	29.6	0.8	18.5	37.5	43.5	38.0	24.0	7.5	8.6	23.6
21	23.0	32.2	28.6	1.1	19.1	37.8	43.7	37.8	23.1	6.4	9.9	23.8
22	23.1	31.7	26.8	1.6	19.7	38.0	**43.8**	37.6	22.1	5.3	11.5	24.2
23	23.1	**31.4**	25.3	2.0	20.4	38.1	43.8	37.3	21.2	4.4	13.2	24.7
24	22.9	31.4	23.5	2.2	21.0	38.2	43.7	37.0	20.4	3.5	14.7	25.2
25	22.7	31.7	21.7	2.1	21.6	38.2	43.4	36.6	19.6	2.8	15.9	25.9
26	22.6	32.3	19.8	1.8	22.3	38.2	43.2	36.2	18.8	2.3	17.1	26.7
27	**22.5**	32.9	17.8	1.3	22.9	38.2	43.0	35.7	18.2	1.8	18.1	27.5
28	22.6	33.5	15.8	0.6	23.5	38.2	42.8	35.2	17.8	1.6	18.9	28.2
29	22.6		13.7	0.2	24.1	38.3	42.6	34.6	17.4	1.6	19.4	29.0
30	22.7		11.7	1.3	24.8	38.3	42.4	34.0	17.1	1.8	19.6	29.7
31	23.0		10.0		25.5		42.3	33.4		2.1		30.5

Sir J. Ross has, on several occasions, remarked that the casual high temperatures are accompanied with cloudy sky and deposition, and vice versâ, and his Tables make it very evident that this is the fact, so far as that portion of the year is concerned which has a temperature below the annual mean: but it is not so as concerns that portion which stands a little above the line of mean temperature. It appears that in high north latitudes the cold side of the year exhibits a regular alternation of periods of high temperature with much deposition, and periods of low temperature with little deposition (this last being no doubt accompanied with a comparatively clear sky, and especially so after the temperature has fallen to the lowest attainable point compatible with a cloudy sky,—the sun's rays then having power enough to disperse any condensed vapour in the atmosphere); and the conclusion, which the evidence of the preceding history fully supports, seems to be inevitable, that there are two localities exhibiting vicarious action; the routine being—deposition as a consequence of reduced temperature, and then increment of temperature as consequent upon the deposition of warm vapour; and the deposition that occurs in the one locality causes a clear sky and great decrement of temperature in another locality, which then takes on in turn the action of deposition, and this is again accompanied with increment of temperature: one of these localities appears to be the high north latitudes, including the magnetic pole and the North of Europe; the other, the northern and central part of North America—(this latter situation doubtless readily acquiring a clear sky and very low temperature in consequence of its inland position). When the northern locality is the site of deposition, vapour is drawn from the Atlantic across the English Channel to the North; and from the Polar seas and the head of Baffin's Bay to the magnetic pole—deposition being, according to Sir J. R., habitually accompanied with a N.E. wind in this neighbourhood: when the western locality is the site of deposition, the vapour is drawn from the Atlantic, in a direction from S.E. to N.W.; and the return current proceeds in an easterly and south-easterly direction towards the English Channel. The coincidence of the dates of high and low temperatures at the magnetic pole and at the Newport station is very remarkable; so also is the correlation of dates,—as regards great and little deposition,—as recorded from observation, or as indicated by the phenomena, at the magnetic pole, with the dates given for these particulars in the text, as indicated by the hygrometric and other phenomena at the Newport site; see, more especially, p.p. 73—75.

It has been intimated that the warm side of the year is not affected in the same manner as the cold side, as regards the influence of deposition and clear sky on temperature; and this is no more than might be expected, because the sun's rays would naturally more than counterbalance radiation in the warm season, and the temperatures belonging respectively to the locality itself, and to the vapour imported, would therefore, have a very different relationship to each other:—the period, accordingly, which intervenes between mean temperature and maximum temperature exhibits an approximation to equality, as regards the influence of increasing and decreasing deposition on the increment and decrement of temperature (see Table 1, below); and the period intervening between maximum temperature and mean temperature is attended with a higher rate of *decrement* of temperature during augmentation of deposition than during diminution of deposition; so that in the one case the rule as given by Sir J. Ross is negatived, and in the other it is reversed: and further,—whilst the last period of augmenting deposition *prior* to max. temperature (June 23—July 10) is accompanied with a rate for increment of temperature of only 0°.09 per diem, the last period of diminishing deposition (July 10—July 21) is accompanied with a rate 0°.37; and whilst the first period of augmenting deposition *subsequent* to max. temperature (July 21—August 13) is accompanied with a rate of decrement of 0°.23, the first period of diminishing deposition (Aug. 13—Aug. 24) is accompanied with a rate of decrement of 0°.14 only.

TABLE 1.

		Rate of increment and of decrement of temperature during augmentation of deposition.	Rate of increment and of decrement of temperature during diminution of deposition.	Means.	Means.
Temp. increasing.	May 8 — May 20	.73			
	May 20 — *June* 5		.57		
	June 5 — June 14	.65			
	June 14 — *June* 23		.40		
	June 23 — July 10	.09			
	July 10 — *July* 21		.37		
				.49	.45
Temp. decreasing.	July 21 — Aug. 13	.23			
	Aug. 13 — *Aug.* 24		.14		
	Aug. 24 — Sept. 5	.54			
	Sept. 5 — *Sept.* 15		.31		
	Sept. 15 — Sept. 25	.78			
	Sept. 25 — *Oct.* 11		.42		
				.52	.39

Table 2 (see p. 145) exhibits in one category the dates and the values for the min. depositions, and in another category the dates and the values for the max. depositions: this table shows that the max. deposition for the year occurs on

April 13: this value is very remarkable, and the deposition is attended with very marked phenomena at the Newport site. On the 13th April the yield of vapour both from the Atlantic and from the Pacific Oceans, in a latitude somewhat to the south of the English Channel, will have been very great,—the sun having crossed the Equator three weeks prior to this date: mean temperature occurs, both at Newport and at the magnetic pole, three weeks subsequent to the date, the temperature is two or three degrees below the respective mean at each spot, the rate of increment of temperature since the occurrence of min. temperature is a little above the average at the magnetic pole and is the same as the average at Newport; the temperature at the former site is 48° lower than at the latter: in the very high latitudes the increment of temperature would be but small; and at the Pole the temperature would probably be little, if anything, above the minimum,—the sun's rays having reached this extreme point only three weeks previously, whilst at the magnetic pole the temperature does not begin to rise until after this lapse of time from the first appearance of the sun. Under these circumstances the interchange of atmosphere between northerly and southerly latitudes would be in very active operation, and the neighbourhood of the arctic circle would be about the line of attraction both for the vaporized atmosphere of the South, and for the cold atmosphere of the North: the condensation of vapour at the arctic circle would be great, by virtue of the temperature belonging to the latitude; but this would be further augmented by the influx of the northerly atmosphere which at this period of the year would have a yet lower temperature. An indication is given as to the source of the vapour condensed at the magnetic pole by the great increment of temperature that accompanies the deposition,—the increment being at the rate of 0°.81 per diem, between March 9 and April 13; which shows an amount of heat which could not belong, at this period of the year, to the vapour from the north, nor can it be attributable to the obscuration of the sky and sun at such a period of the year: the amount of vapour sent to the longitude of the magnetic pole, situated as this is, at the arctic circle, between the Atlantic and Pacific, would be greater than that at the longitudes of eastern Europe; but the increment of temperature in the latter situation would be comparatively small in consequence of its proximity to the northern ocean: subject to these conditions the deposition might be very profuse to the eastward of the Newport site at first, and for a short time, but it would preponderate in the opposite direction subsequently; and then low temperature would preponderate in the former situation, owing to the clear sky and rarefied atmosphere resulting from deposition elsewhere. The phenomena at the Newport site afford an indication of the period when deposition preponderates in the West, and clear sky in the East (see pages 33 and 106): the

N.E. winds have their max. value for the year during April 17—20, and humidity attains its min. value on April 21; from which it may be inferred that the North-east has acquired a clear atmosphere. On May 8 the deposition (as shown in the Table) falls to a minimum in the West, and on May 7 the S.W. wind supplants the N.E. at Newport. Three other very high values occur in September and November; and that of November serves well to illustrate the influence of deposition upon temperature;—the rate of decrement being 0°.22 for the fifteen days prior to November 6, and 0°.80 for the fifteen days following.

This Table also shows that but little deposition occurs at the hottest and coldest periods of the year; the min. value for the year falling on February 11,—a date which is close to the min. temperature, both for Newport and for the magnetic pole. The next lowest value falls on March 9, a date remarkable for the very low vapour pressure and the max. value for air-pressure at the Newport site (see page 29), and having been preceded by a reduction of the increment of temperature to nearly 0, on March 3. The great depositions occur—first, when the production of vapour becomes great in the South; secondly, when the decrement of temperature has become considerable in the North; and again, thirdly, when the reduction of temperature has become great.

TABLE 2.

	Values, in hours, of min. deposition.		Values, in hours, of max. deposition.
Jan. 5	1.7	Jan. 17	4.1
Feb. 11	0.4	Feb. 23	1.3
Mar. 9	0.5	Apr. 13	6.2
May 8	1.3	May 20	3.6
June 5	2.5	June 14	3.9
June 23	2.6	July 10	3.7
July 21	1.8	Aug. 13	3.1
Aug. 24	1.5	Sep. 5	5.9
Sep. 15	2.8	Sep. 25	4.3
Oct. 11	3.0	Nov. 6	5.8
Nov. 26	1.5	Dec. 5	2.6
Dec. 15	1.3	Dec. 27	2.2

There are three principal dates for high temperature, and three principal dates for low temperature; there are also three dates both for high and for low temperature of minor importance, as shown in Table 3. The minor maximum of November 4 occurs during the declining period of the year, and prior to mean temperature, and is associated with a max. value for deposition on Nov. 6; and corresponds with the Martinmas summer of England, and the abatement of deposition there: December 6 is associated with a max. value for deposition on Dec. 5, and corresponds with a retrogression of temperature at the Newport site on the same day. The minor minimum of April 24, which occurs in the ascending period of the year, is associated with a great abatement in the deposition and implies a clearer sky; and this corresponds with the min. value for humidity at Newport on April 21: October 28 is in the decline of the year and figures as a min. value merely in consequence of the rise that succeeds: November 30 stands upon a similar footing with Oct. 28, but it is associated with a min. value for deposition on Nov. 26.

TABLE 3.

Low Temperatures.		High Temperatures.	
January . . 5	−32°.4	−22°.5	January . . 27
February. . 13	−37 .8	−31 .4	February . 23
March . . . 5	−34 .9	− 0 .5	*April* 17
April 24	− 2 .2	+43 .8	July. 22
October . . . 28	+ 1 .6	+ 2 .4	*November* . 4
November . 30	−19 .6	−17 .8	*December*. . 6

The dates for the *principal* high and low values for temperature correspond very closely with the dates for similar values at the Newport site. January 27 corresponds with a marked maximum at Newport on January 24 which occurs under the influence of a S.W. wind, and is accompanied with indications of a cessation of deposition (see page 73) at the magnetic pole; there is no deposition sufficient to account for the high temperature, though the max. deposition of the 17th may be a helping agent, and this deposition, moreover, corresponds with the max. *rate* of increment at Newport on January 18, and the max. value for cloud in the year, on the 19th: January 27, then, seems to occupy an intermediate position between the season of deposition, and that of clear sky with the greatest depression of temperature;—accumulation of vapour and cloudy sky being substituted for deposition; and this being subsequently exchanged for an opposite state of matters; *i.e.*—the vapour is dissolved in the upper strata of the atmosphere under the increasing influence of the sun's rays, the sky becomes clear, radiation from the surface of the earth is active, and the temperature of the superincumbent atmosphere is reduced to its lowest value: February 23 is associated with the lowest max. value for deposition, and corresponds with a great increment of temperature at Newport on the same date, and with indications of moderate deposition in the North (see page 23): July 22 gives the max. temperature for the year; it is associated with a min. value for deposition; and it corresponds with the max. temperature of Newport, —intervening just midway between the preliminary and the principal maximum. The minimum value on January 5 is associated with a min. value for deposition; and corresponds with the preliminary minimum of Newport: February 13 is associated with a min. value for deposition on the 11th; and corresponds with the min. value for Newport on the 11th, which, like that of the 13th, is the principal minimum for the year: March 5 is associated with a min. value for deposition on March 9; and corresponds with March 8 at Newport, where the increment of temperature is reduced nearly to 0; this, together with other particulars, has been noticed above in referring to the deposition for this date.

On page 149 a number of low temperatures are given in a tabulated form, which have been collected from the recorded observations of several of the Arctic explorers.

Among the Stations noticed in the Table, No. 5 is situated in the latitude of the magnetic pole: No. 1 is situated seven degrees to the south of the magnetic pole: No. 12 is seven degrees north of the magnetic pole. The mean of the thermometric values for the twelve Stations is 54°.4: the mean of the five values for No. 1 is 60°: the mean of the four values for No. 12 is 57°. The dates of occurrence for No. 1 include December 23—February 21: the dates for No. 12 include January 12—March 14; giving a difference of three weeks for the two Stations. The nearer the Station is to the Pole, the later is the date of its lowest temperature likely to be:—the date being in all probability later than March 21, at the Pole. The site of Fort Reliance is, probably,—looking to its geographical and topographical position—the site of the lowest temperature that any locality is subject to: a line carried W.N.W. from the English Channel is concurrent with the north coast of America. The lowest mean annual temperature would in all probability belong to a latitude somewhere between the extreme north—which is surrounded by an extensive sea area, and the latitude of lowest temperature—which is connected with an extensive land area: the site of the magnetic pole is probably that of the lowest mean annual temperature.

Protracted periods of very low temperature were experienced at Rensselaer Harbour, by Dr. Kane. During the twenty months (September 1853—April 1855) over which his record for this Station extends, there were nine occasions on which the temperature was as low as $-60°$; and these occasions were distributed over the interval, December 24—February 6: there were fifty occasions on which the temperature was noted between $-50°$ and $-59°$; distributed over the interval, November 29—March 28: there were thirty-three occasions on which the temperature was noted between $-45°$ and $-49°$; distributed over the interval, November 30—March 30. Dr. Kane found March to have the lowest mean monthly temperature; the mean value for the two months of March being $-36°$.

TABLE OF LOW TEMPERATURES.

	STATION.	LATITUDE.	LONGITUDE.	TEMPERATURE.	DATE.	YEAR.
No. 1	Fort Reliance ………	63° N.	109° W.	− 57°	December 31	1833
				− 70	January 17	1834
				− 60	February 4	1834
				− 58	December 23	1834
				− 56	February 21	1835
,, 2	Fort Enterprise ……	64	113	− 57	December 29	1820
,, 3	Repulse Bay ………	66	87	− 47	January 8	1847
,, 4	Melville Peninsula …	69	82	− 45	January 3	1823
,, 5	Felix Harbour, etc. …	70	92	− 60	January 5	1831
				− 51	March 21	1831
,, 6	Port Kennedy………	72	94	− 47	December 26	1858
				− 48	February 18	1859
,, 7	Port Bowen…………	73	89	− 47	March 2	1825
,, 8	Port Leopold ………	74	90	− 56	December 15	1848
				− 60	February 25	1849
,, 9	Assistance Bay ……	75	94	− 45	February 24	1851
,, 10	Melville Island ……	75	110	− 54	January 14	1820
				− 50	February 15	1820
,, 11	Melville Island ……	75	109	− 55	January 26	1853
				− 54	February 10	1853
,, 12	Northumberland Sound.	77	97	− 62	January 12	1853
				− 57	March 4	1853
				− 59	January 30	1854
				− 50	March 14	1854
,, 13	Rensselaer Harbour..	79	71	− 68	February 5	1854
				− 69	January 7	1855
				− 67	January 8	1855

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